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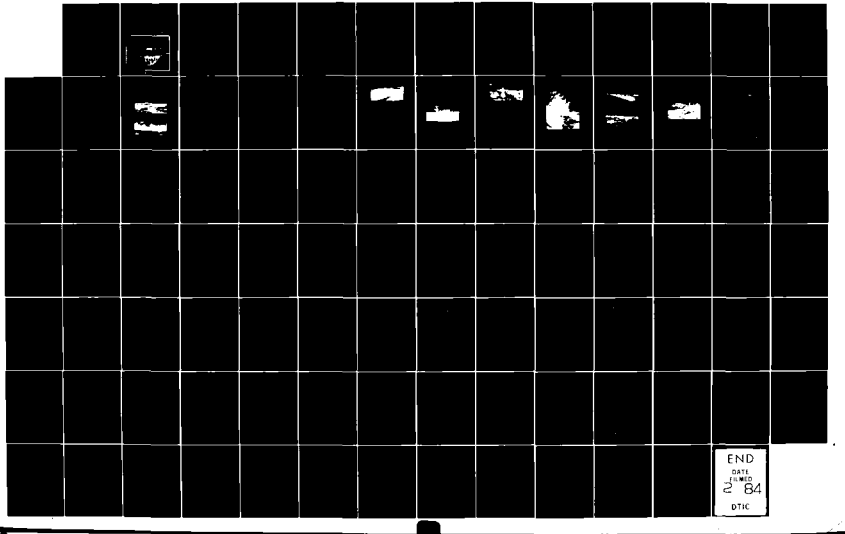

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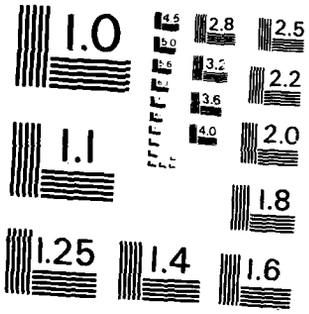


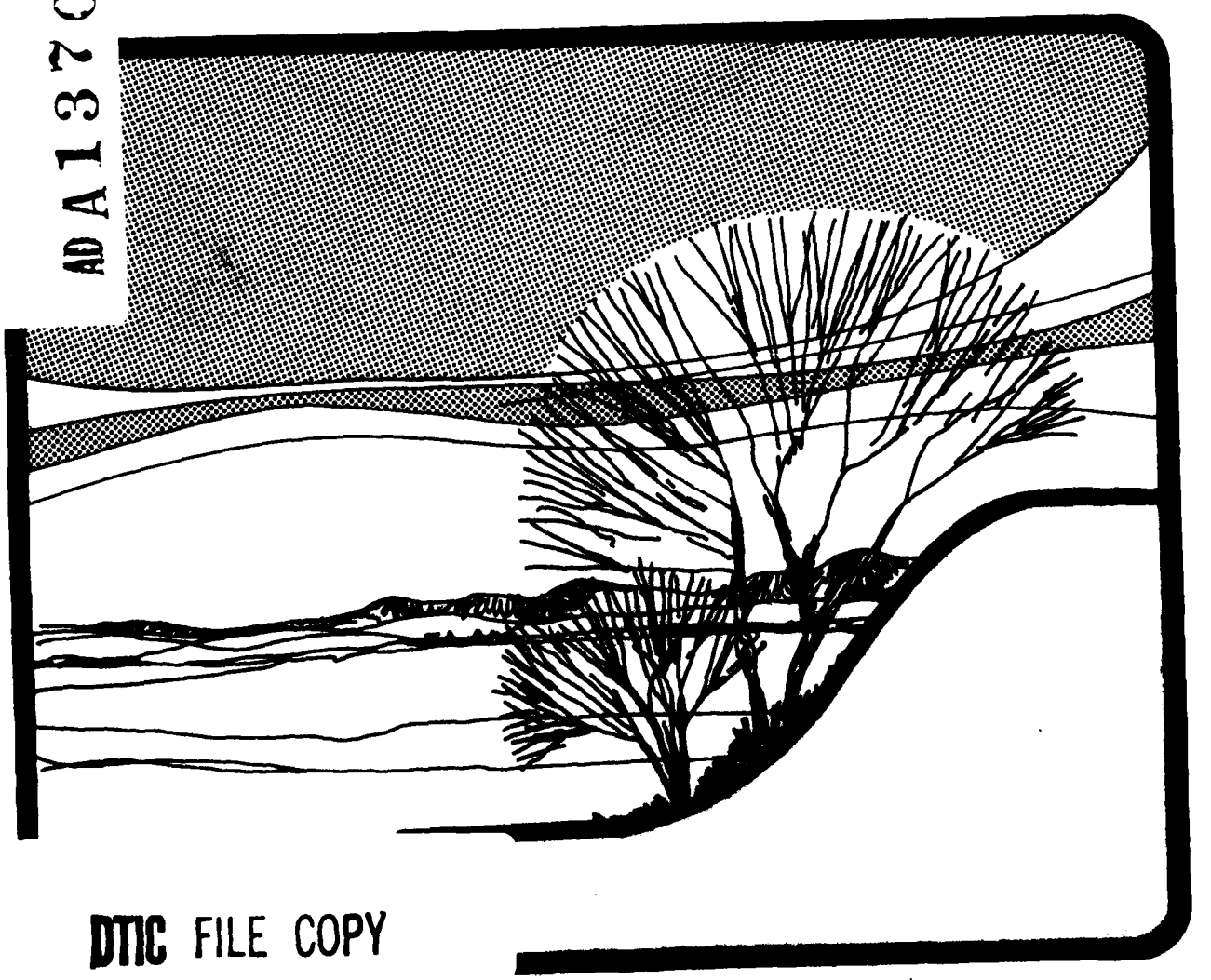
Master Plan

Tucson Diversion Channel

Recreation Development Program

March 1980

Gila River and Tributaries Arizona and New Mexico



U.S. Army Corps of Engineers, Los Angeles District

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Dryland recreation facilities, a multi-purpose lake, and needed support facilities will be developed in the Tucson Detention Basin. The Basin is a unit of the existing Tucson Diversion Channel Flood Control Project. The purpose of this plan are to (1) to propose a coordinated development plan for all project resources; and (2) provide a basis for advancing to detailed design under the Code 710 program.

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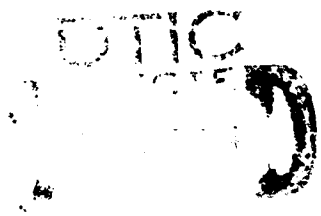
MASTER PLAN

TUCSON DIVERSION CHANNEL

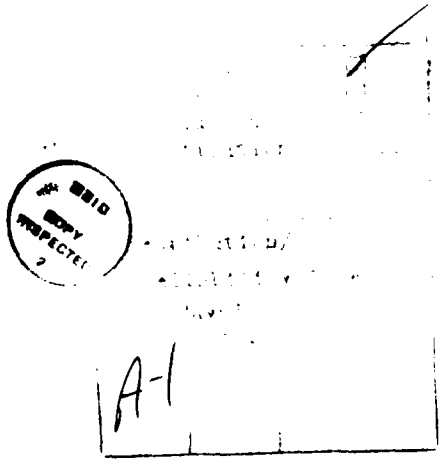


MARCH 1980

Preface

Under this master plan, dryland recreation facilities, a multipurpose lake, and needed support facilities will be developed in the Tucson Detention Basin. The basin is a unit of the existing Tucson Diversion Channel Flood Control Project. The proposed facilities will be developed in two major phases of recreation development under the Code 710 Program, in cooperation with Pima County, Ariz., the local sponsor of the proposed project.

The purposes of this master plan are to (1) propose a coordinated development plan for all project resources; and (2) provide a basis for advancing to detailed design under the Code 710 program. Upon plan approval, a detailed feature design memorandum will be prepared.



Previously Issued Design Memorandums

Review Report on Interim Survey for Flood Control. Tucson, Arizona, and Vicinity, Gila River Basin, Ariz. and New Mexico. U.S. Army Corps of Engineers. Col. C.T. Newton, District Engineer; January 26, 1959.

Draft Letter Report — Tucson Detention Basin Ajo West Park. Prepared by U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, California; May 1978.

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GLOSSARY OF TERMS

ASTM	American Society for Testing and Materials
BOD	Biological oxygen demand
CBEA	Cella Barr, Evans and Associates
CBR	Cost-benefit ratio
EIS	Environmental impact statement
EPA	Environmental Protection Agency
ER	Engineering Regulation
LADM	Los Angeles District Manual
mg/BOD	Million-gallon biological oxygen demand
NED	National Economic Development
NS	No standard
Par course	A system of exercise stations used for recreation
PVC	Polyvinyl chloride
SS	Suspended solids
TDS	Total dissolved solids
USGS	U.S. Geological Survey

1. Introduction

A. Project Authorization. The Tucson Diversion Channel project was authorized by Public Law 80-858, approved 30 June 1958. Pursuant to a resolution of the Committee on Public Works of the United States Senate, dated 17 March 1955, the plan was modified as detailed in a review report dated 26 January 1959. Construction of the flood control project was initiated on 16 April 1963 and completed on 12 April 1966. The project was transferred to the Board of Supervisors of Pima County for operation and maintenance on 11 August 1966.

The Flood Control Act of 1944 (Public Law 78–534), as amended, authorizes the Corps to construct, maintain, and operate public park and recreational facilities at water resource development projects. The law also permits the Corps of Engineers to authorize local interests to construct, maintain, and operate recreation facilities. Under the Code 710 program as outlined in EC 11-2-127, dated 15 April 1977, Federal funding is available for recreation facilities at completed Corps projects, provided local agencies furnish 50 percent of the development costs.

The proposed recreation development project will be built on county-owned lands originally acquired for flood control. Approximately 20 acres, acquired by Pima County, will be needed for access, parking, and operation of the facility. A cost-sharing agreement wil be established whereby Pima County will pay 50 percent of the cost-shareable development expenses for recreation and 100 percent of the noncost-shareable development expenses prior to construction. The county will also assume all operation and maintenance responsibilities upon project completion.

B. Project Purpose. The detention basin's primary purpose will remain flood control; but this report will demonstrate that the proposed dryland and water-based recreation facilities can be incorporated without sacrificing the basin's efficiency or design capacity.

The need for additional land- and water-based recreation facilities has been established in the Tucson and Eastern Pima County regions. The proposed multipurpose facility will therefore generate recreation benefits in addition to the present flood control benefits.

C. Purpose of the Master Plan. The master plan for Tucson Detention Basin will serve as a guide to ensure optimum development of the basin's natural and recreation resources. This plan is based

upon an inventory and analysis of the opportunities and constraints for recreation development. The physical plan for recreation development, the proposed phasing, and associated costs and benefits for the project will be presented.

D. Scope of the Master Plan. The master plan will provide a general overview of the existing flood control features. It will present a concise analysis of both local and regional recreation demands and of existing and future land uses. It will also describe the basin's existing natural resources: how they will be utilized and impacted by the proposed development; and how the proposed recreation facilities will be incorporated into the existing flood control structure.

Critical issues raised by the local population will also be discussed. A series of public meetings, held in 1977, brought out relevant areas of concern, such as groundwater use, wildlife habitat destruction, and the noise levels that may be generated by the project. These issues will be considered in the body of the report.

Finally, the report will present the costs and schedule for project development, and the specific responsibilities of the Corps and the local project sponsors, Pima County, Ariz.

E. History of the Project. In the early 1970s, the Pima County Board of Supervisors expressed substantial interest in developing water-based recreational facilities within the Tucson Detention Basin. The Board appointed a Citizens Committee Bond Advisory Council, which recommended a bond election. A special election was held in February 1974, with 62 percent of those voting in favor of the bond issue.

On 3 March 1975, Pima County retained the professional engineering services of Cella, Barr, Evans and Associates (CBEA) to determine the feasibility of planning, constructing, maintaining, and operating a lake and associated park facilities. If the project proved feasible, CBEA was to prepare a preliminary design and management plan. In January 1976, CBEA published its initial findings, having determined that it was feasible to design and construct a multipurpose lake and facilities in the detention basin. CBEA referred to the proposed recreation area as the "Ajo Way Detention Basin Wet Park."

In April 1976, the Corps of Engineers was invited to participate through the Code 710 program. In June 1976, the Los Angeles District Office received a letter of intent submitted by the Pima County Board of Supervisors, requesting Corps participation in a joint effort to develop recreational facilities in the basin. On 5 May 1977, the Corps met with representatives of Pima County, and the research leading to the Letter Report of May 1978 was initiated.

In September 1977, with the recommendation of the Pima County Parks and Recreation Department, the mayor and the City Council of Tucson agreed by unanimous vote to divert water from the secondary treatment plant at Randolph Park to the Tucson Detention Basin for tertiary treatment and ultimate use in the proposed lake.

In April 1978 it became evident that the local sponsors had problems with funding for the lake recreation development, because of the increase in construction costs since 1976, when the CBEA Report was published. Alternative funding proposals were formulated.

In May 1978 the letter report was submitted to the Corps' division office for review with alternative funding proposals and phasing of development. In September 1978 comments were received from the division office. These included a statement that a treatment plant, as outlined in the letter report, was not a cost-shareable item. This decision placed additional financial burdens on the local sponsor.

Cost-feasible alternative tertiary treatment methods were also investigated. In March 1979 Rod Gomez and Associates were commissioned to investigate the lake water supply in more detail. Their report, completed in November 1979, uncovered problems with the plant's operating capacity and determined the water quality of the effluent. Higher cost estimates were quoted for the tertiary treatment part of the proposed project.

Alternative phasing of the recreation development was proposed with the dryland facilities to be constructed in the first phase. This alternative was presented to the Pima County Parks Commission in December 1979 and was approved by the Board of Supervisors in January 1980. (See the Letter of Approval, Appendix A.)

F. Final Environment Assessment. The Los Angeles District has prepared a final environment assessment on the proposed project. This assessment can be found in Appendix B.

G. Pertinent Regulations and Publications. The following regulations and publications were used in the preparation of this master plan.

1. Regulations. EC11-1-127 — Code 710 Program, Recreation Development at Completed Projects, 15 April 1977.

ER1110-2-400 — Design of Recreation Sites, Areas, and Facilities, 7 July 1972.

ER 1120-2-400 — Investigations, Planning and Development of Water Resources, Recreation Resources Planning, 1 November 1977.

2. *Publications.* Review Report On Interim Survey For Flood Control, Tucson, Arizona, and Vicinity, Gila River Basin, Arizona and New Mexico. U.S. Army Corps of Engineers. Col. C.T. Newton, District Engineer, January 26, 1959.

Design Memorandum No. 1, General Design Memorandum for Tucson Diversion Channel, Tucson, Arizona. November 1962.

Ajo Way Detention Basin Wet Park Feasibility Design Study, Initial Design. Cella, Barr, Evans and Associates, Tucson, Arizona. January 1976. Final Report.

Parks, Recreation and Open Space: A Conceptual Plan for Tucson-Pima County, June 1978, Briscoe, Maphis, Murray and Lamont, Inc., Key/Fletemeyer Associates, Boulder, Colorado.

Feasibility Study: Proposed Wet Park at the Tucson Detention Basin, Pima County, Arizona. RGA

Consulting Engineers, November, 1979.

3. Application of Public Laws. The following Federal laws provide for the development and management of Federal projects for various purposes, according to the intent of Congress.

a. Public Law 534–78 (Flood Control Act of 1944), as amended by the Flood Control Acts of 1946, 1954, 1960, and 1962, authorizes the Corps of Engineers to construct, maintain, and operate public park and recreation facilities at water resource development projects and to permit local interests to construct, maintain, and operate such facilities.

b. Public Law 89-72 (Federal Water Project Recreation Act of 1965), accompanied by House Committee Report No. 254, requires that full consideration be given to opportunities that the project affords for outdoor recreation and for fish and wildlife enhancement. It also provides for non-Federal participation in land acquisition and in the development and management of recreation facilities and fish and wildlife resources.

c. Public Law 91–190 (National Environmental Policy Act of 1969) requires that an environment assessment be prepared for every Federal project. A final environmental assessment on the proposed project has been prepared and can be found in Appendix B. The final environment assessment determined that there is no need to prepare an environmental impact statement.

d. The 1974 Water Resources Development Act (Public Law 93-251), as well as earlier and related legislation prescribes that water quality and water pollution control must be given full consideration in the planning and construction of federal water resources development projects.

H. Project Description.

1. *Location.* The existing flood control project, which was completed, in 1966, is in southeast Tucson in Pima County, Arizona. The detention basin is north of Ajo Way and west of Country Club Road. (See figure 1.) The project protects developed areas in and around the city of Tucson, as well as residential property in the overflow area along Julian Wash, against flooding. It intercepts flows from the upstream part of the Tucson Arroyo and the Railroad Wash drainage areas, and diverts these flows around the southern edge of Tucson and into the Santa Cruz River.

2. Project Features. The project drains a 47.6-square mile area. The detention basin was constructed by building dikes about 20 feet high around an area of about 120 acres. The existing basin and spillway system provides sufficient regulatory storage to reduce the standard project flood from an inflow peak of 15,300 cubic feet per second (f^3/s) to an outflow peak of 9,300 f^3/s. The total design storage capacity is 1800 acre-feet.

The project includes an interceptor levee, channel, detention basin, inlet channel, and outlet channel. (See photos 1 and 2.) Components constructed by the Federal Government include two railroad bridges side drainage inlet structures, access roads, invert-access ramps, and safety fencing. Other project components, constructed by local interests, include highway bridges at major crossings and relocation of public and private utilities.

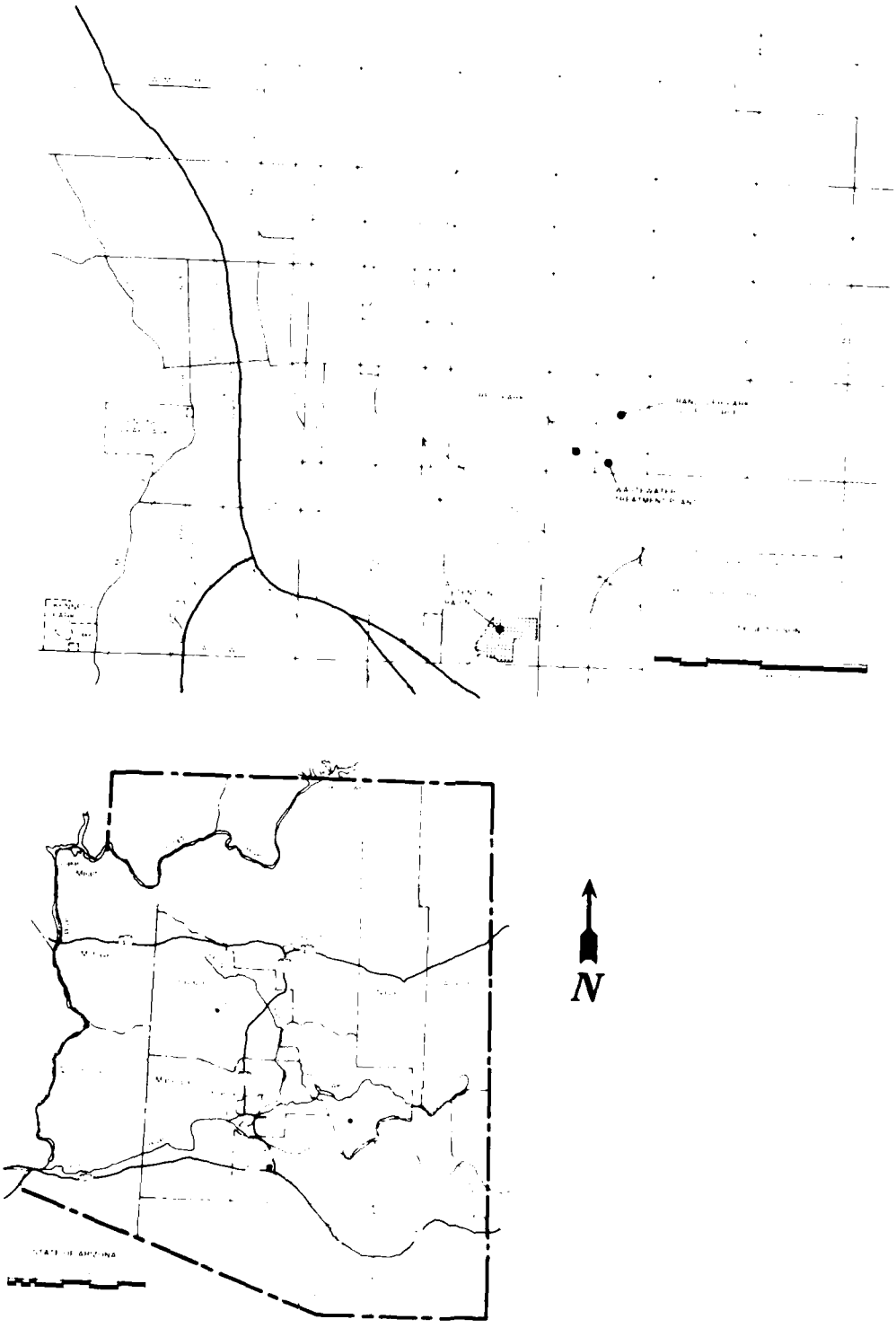


Figure 1. Project Location.

3. Basin Hydraulics. The greatest floods in the drainage area result from local thunderstorms of high intensity and short duration. These thunderstorms are common during the summer. During such storms the duration of critical rainfall intensity is seldom more than 2 hours and rarely more than 3 hours. The greatest intensity usually occurs shortly after the beginning of the storm.

The effect of snowmelt on floods in the Tucson metropolitan area is negligible.

Photo 1. Looking East Toward the Inlet Channel of the Tucson Detention Basin.

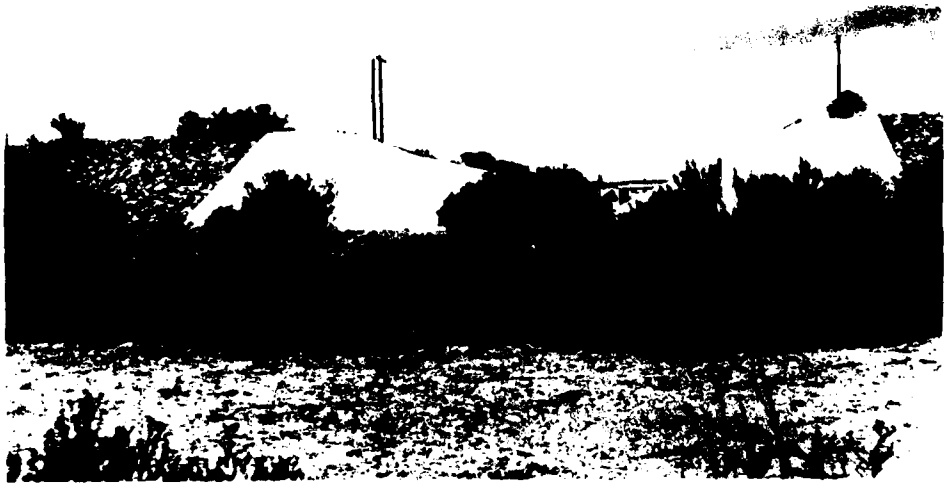


Photo 2. Looking Southwest at the Outlet Channel of the Tucson Detention Basin.

4. Basin Operation. The basin is designed for a standard project flood (SPF) of 15,300 f^3 s. Under existing conditions, the SPF depth relationship in the basin would be as follows.

Elapsed Time	Peak Discharge (f^3 s)	Approx. Water Depth in Basin (feet)
30 min.	1,000	1
40 min.	2,000	1
1.0 hour	5,000	1
1.5 hours	10,200	4
2.5 hours	15,300	13

The existing basin can drain its capacity of water in one day. Construction of the proposed project would not alter the SPF inflow-depth relationship in the basin.

5. Operation and Maintenance. The diversion channel project is operated and maintained by the Pima County Board of Supervisors in accordance with LADM 1130-2-46, Operation and Maintenance Manual for Tucson Diversion Channel, Tucson, Arizona. This document makes it the responsibility of the Board to inspect, maintain, and operate the facility to insure serviceability of the structure in time of flood.

2. Resource Base

A. Environmental and Cultural Resources.

1. Climate. The climate of the project area is subtropical and semiarid. The winters are short an mild, and the summers are long and hot. For a 64-year period, the average monthly temperature recorded by the United States Weather Bureau Station at Tucson ranged from 49.6 Fahrenheit (F) for January to 86.8°F for July. (See fig. 2.) Mean annual precipitation at Tucson is estimated at 10.5 inches. Most precipitation in the area occurs during the winter and summer months; the spring and fall months are relatively dry. The prevailing winds are from the southeast at 8.1 mph.

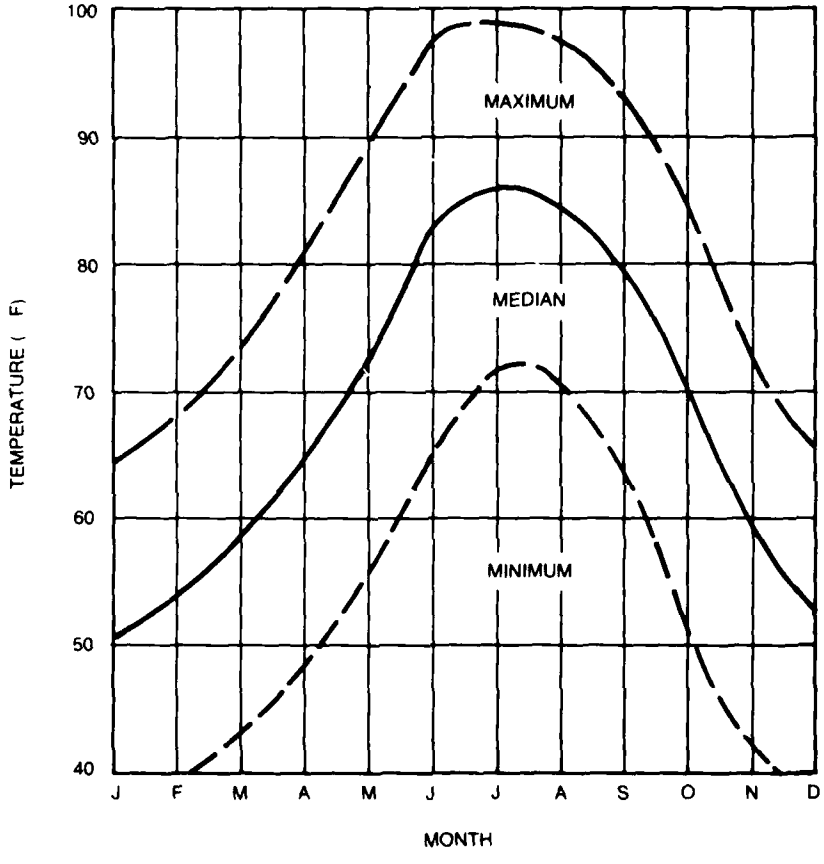
2. Physiography. The area of the man-made detention basin is approximately 120 acres. The basin is flat and contains a low flow channel approximately 2450 feet in length. (See photo 3.) Twenty-foot-high earth levees surround the basin on three sides. Drainage patterns in the upper half of the basin have been disturbed by earlier sand and gravel operations. Large piles of earth and debris remain, now causing storm water to pond temporarily in the upper half of the basin.

3. Hydrology. (See Basin Hydraulics, discussed in Chapter 1, Project Description.)

4. Groundwater. Supplies of ground water in the Tucson area are diminishing. Groundwater withdrawals for both irrigation and commercial-industrial uses have caused large groundwater level declines in the Tucson area (Arizona Water Commission Bulletin 9, February 1975). The depth of water in two wells in the Tucson area has increased from 210 to 231 feet and from 83 to 126 feet respectively between 1969 and 1974 according to the U.S. Geological Survey (USGS). Annual pumpage in the upper Santa Cruz basin has increased from about 160,000 acre-feet in 1950 to about 253,000 acre-feet in 1971.

The depth of groundwater in the basin was tested to a depth of 30 feet. In 10 test holes drilled, no groundwater was encountered. A 1972 USGS map indicates that the probable depth of groundwater in the basin is 100 to 200 feet.

5. Reclaimed Water Supply. Because of the critical groundwater shortages in the project area, alternative sources for the lake's water supply were investigated. Among the alternatives were secondarily treated waste water from Randolph Park Plant, blowdown water from the Tucson Gas and Electric Company, and storm water. The most feasible source was determined to be effluent from the Randolph Park Plant. This water source was recommended in the Letter Report submitted for review in May 1978.



SOURCE: UNITED STATES WEATHER BUREAU RECORDS

Figure 2. Air Temperatures for the Tucson Metropolitan Area.

Photo 3. Piles of Sand and Gravel Debris (in Middleground of Photo). The Low Flow Channel is Located Where Vegetation is Growing in Background.

Further investigations were made to determine the quantity and quality of this water source and what type of treatment will be necessary to bring the water up to the water quality standards required for recreational use. A study completed in November 1979 by Rod Gomez and Associates indicated that the Randolph Plant was not currently operating at its full capacity. The firm determined that construction of a lift station would be necessary to bring additional effluent to the plant, which presently processes 1.0 million gallons per day (mgd). In order to get enough surplus effluent for a 60-acre lake, the plant's capacity would have to be increased to 1.5 mgd.

Alternative water treatment methods were also investigated. It was determined that land treatment was the most economically feasible method to bring the effluent to Environmental Protection Agency (EPA) recreation water standards.

Further elaboration of this proposed treatment method will be found under the description of the plan. (See Chapter 3, C and D.)

6. Soils. The soil of the basin is predominantly clayey sands, with irregular occurrences of sandy clays and borderline sands having 3 to 19 percent moisture content; the average being 10 percent. Materials in the southern half of the basin are cemented to some degree by caliche (a soil cemented by calcium carbonate). (See the Soils Investigation Report, Corps of Engineers, September 1977.)

There are no mineral deposits within the basin site. The soil is strongly calcareous and is moderately alkaline, with a pH between 7.9 and 8.4. It has high corrosivity to uncoated steel and low corrosivity to concrete.

7. Archeology. There are no records of archeologic sites or other cultural resources within the detention basin itself. There are, however, two Hohokam shard sites, circa 900-1300 A.D., located within one mile of the detention basin. One of the sites, currently occupied by an abandoned service station, is at the southwest corner of Ajo Way and Palo Verde Road; the other site is located north of Irvington Road between Country Club Road and I-10, on the north bank of Julian Wash.

8. Vegetation. During the construction of the detention basin in the mid-1960s, the site was cleared of all native vegetation, which was predominantly creosote-scrub. Since that time, both the increased moisture resulting from flood control and the fact that the basin has not been routinely maintained has resulted in diverse and lush native plant growth. (See photo 4.) This new vegetation is markedly different in species composition from that of the surrounding area.

Photo 4. Typical Vegetation in the Tucson Detention Basin.

Although it must be classified as a disturbed area, the site appears to be a transitional zone between desert grassland and forest community. This condition is the direct result of the additional available moisture. Such zones often occur in areas where human activities have changed the drainage pattern of the landscape.

On the levee walls where moisture is scarce, the vegetation consists of grasses, shrubs and a few cholla cactus (Sorghum, Phalaris Baccharis, Psilostrophe, Opuntia, and Larrea). (See photo 5.)

Photo 5. Grasses and Shrubs on Levee Walls Where Moisture is Scarce.

On the inner slope of the northwest levee, the vegetation cover is noticeably denser. This is a result of the prevailing pattern of drainage toward the Santa Cruz River. On this slope creosote bush, palo verde and mesquite trees are found. The bottom of the basin is covered with tall shrubs (Baccharis) and annual grasses, which are gradually being covered with sediment brought in by storm runoff. In isolated depressions scattered throughout the basin grow tree species that are members of the deciduous riparian forest communities. These species include cottonwood, mesquite, tamarisk, and palo verde. Some of these trees are over 20 feet tall. (See photo 6.)

9. Wildlife. The diverse vegetation and increased moisture availability have created an area of rich wildlife habitat. The safety fence surrounding the project has discouraged public use and permits the various species of birds and mammals to inhabit the area with a minimum of human disturbance. During site investigations, jack rabbits *(Lepus)*, quail *(Lophortix gambelii)*, and a few lizards were seen. It is reasonable to assume that animals such as javelina (*Peccari*) and deer (*Odocoileus*) once inhabited the site but have since been displaced by urbanization. In addition, this riparian forest habitat is probably a nesting site for game birds, including whitewing doves (*Zenaidura asiatica*) and the previously mentioned Gambel quail.

10. Visual and Spatial Quality. The visual quality of the basin is relatively high when contrasted with the surrounding landscape and land use. The open space around the perimeter of the basin is covered with creosote-scrub vegetation, which is rather monotonous in character. To the north and west, residential property consisting of lower income single family homes, fences, and backyard alleyways can be seen from the levees of the basin. (See photo 7.) To the east, the industrial property is a decided contrast to the basin: the view in this direction is of tall storage tanks, warehouses, and powerlines. (See photo 8.) To the south, the county facilities are unobtrusive: the large county hospital is the visually dominant element of the group.

Photo 6. Palo Verde Trees on the Northwest Levee.

Photo 7. On the North Levee, Looking Northwest to the Residential Area.

Photo 8. Looking Across the Detention Basin to the Industrial Area on Country Club Road.

From the 20-foot levee walls, all areas surrounding the basin as well as all points within the basin are clearly visible. These levee walls also screen the activities within the basin, except for isolated views available to motorists on Ajo Way.

Within the detention basin the visual quality is good, due to the vegetation. Its diversity in size, shape, and color adds to the visual interest of the flat site. The large Baccharris shrubs, which dominate the bottom of the basin, create a tall cover of bright evergreen shrubs. Because they are taller than human eye level, these shrubs create spatial diversity and offer a sense of discovery for a visitor. This is important because the vast expanse of the basin is sometimes overwhelming to the first-time visitor. Some tall tamarisk, palo verde, and mesquite trees add a vertical dimension. The canopy of trees provides shelter and pleasantly modifies the scale of the basin. (See photo 9.)

Photo 9. Canopy of Tall Mesquite Trees Adds Vertical Dimension.

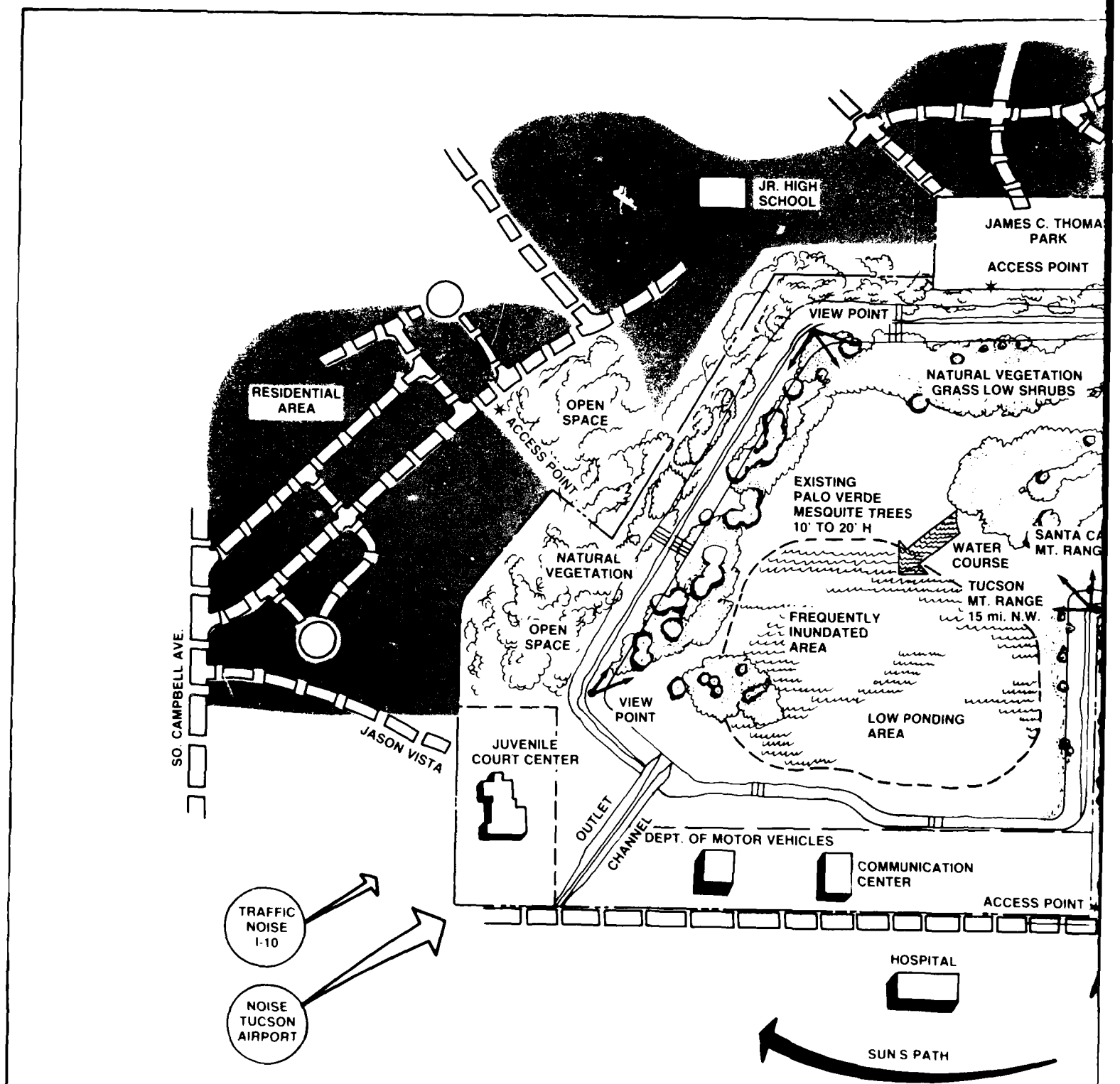
Low-lying annual grasses create a rich texture on the ground plane. Their annual character provides color and height variations throughout the year.

Noise within the basin is significantly reduced, due to the levee walls. But jet noise from Davis Monthan Air Force Base will occasionally interrupt the basin's prevailing sense of tranquility.

Plate I illustrates the significant site features found in the Tucson Detention Basin.

B. Social and Economic Factors.

1. Population Characteristics. Eastern Pima County contains nearly one-half milllion people. By the year 2000, the population of Pima County is expected to grow to 746,000. The minority populations of this region reflect the historic cultures of the area. Approximately 20 percent of the residents are Spanish or Mexican; approximately 3 percent are Native American Indian; 3 percent are


JR. HIGH SCHOOL
JAMES C. THOMAS PARK
ACCESS POINT
VIEW POINT
NATURAL VEGETATION GRASS LOW SHRUBS
RESIDENTIAL AREA
OPEN SPACE
ACCESS POINT
EXISTING PALO VERDE MESQUITE TREES 10' TO 20' H
SANTA CA MT. RANG
WATER COURSE
NATURAL VEGETATION
TUCSON MT. RANGE 15 mi. N.W.
OPEN SPACE
FREQUENTLY INUNDATED AREA
SO. CAMPBELL AVE.
JASON VISTA
VIEW POINT
LOW PONDING AREA
JUVENILE COURT CENTER
OUTLET CHANNEL
DEPT. OF MOTOR VEHICLES
COMMUNICATION CENTER
ACCESS POINT
TRAFFIC NOISE I-10
NOISE TUCSON AIRPORT
HOSPITAL
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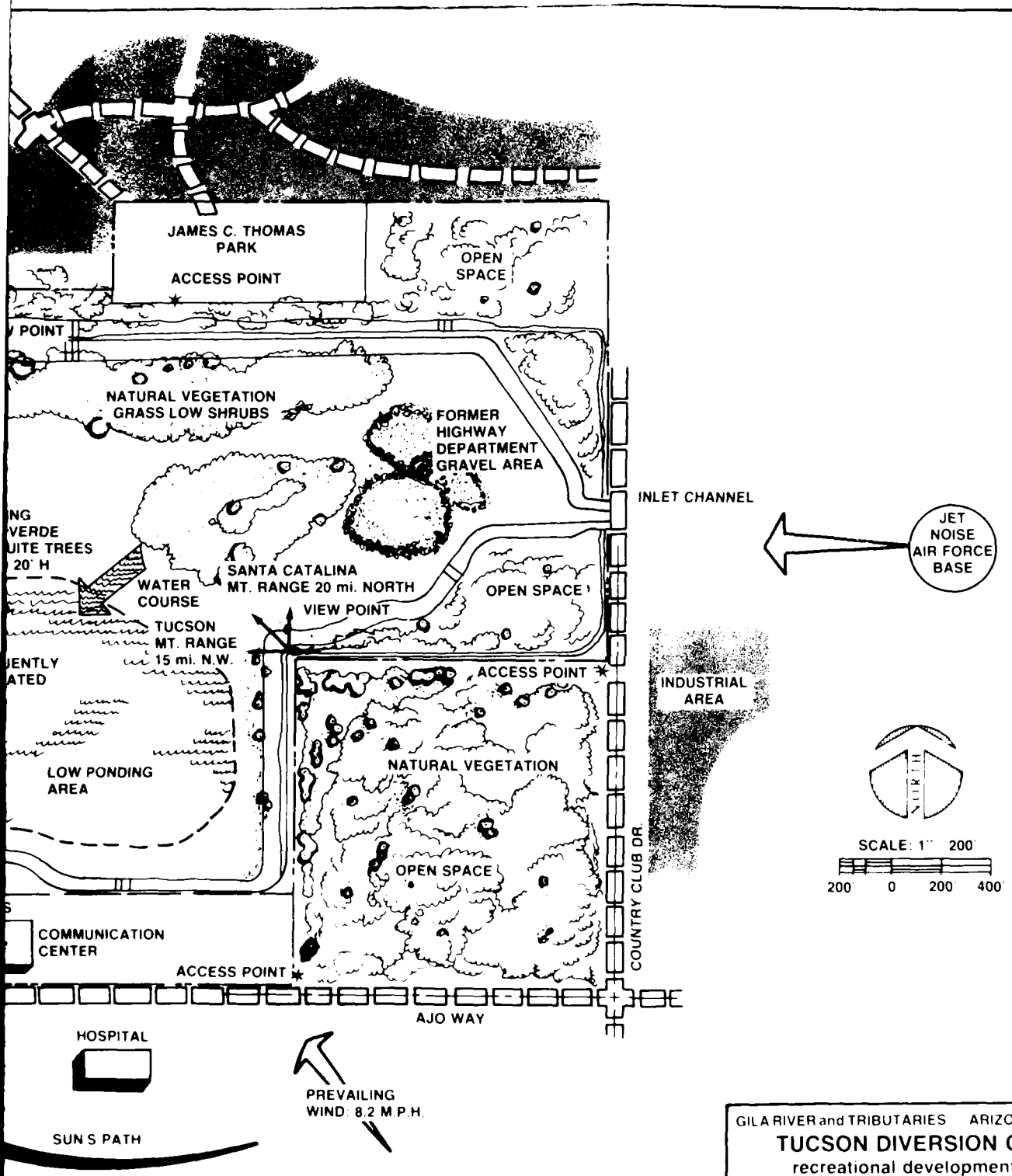


GILA RIVER and TRIBUTARIES ARIZONA and NEW MEXICO

TUCSON DIVERSION CHANNEL

recreational development program

u.s. army corps of engineers los angeles district

SITE ANALYSIS

PLATE 1

2

black; and Anglo-Americans make up the remaining 74 percent. Senior citizens in Pima County comprise 10 percent of the population: between 1970 and 1975, this age group increased by 27 percent.

2. Education and Income. The preferred types of recreation and rates of participation are closely related to a population's education and income levels.

The average adult educational levels in the community are higher than national or state averages. The 1976 statistics show that 80 percent of the Tucson residents over 25 years old had graduated from high school, compared with 60 percent in 1970.

The area's median income is also on the increase. Family median income increased 36 percent between 1970 and 1976, and is now comparable to other growing metropolitan areas of the Southwest.

3. Existing Land Use and Patterns of Growth. The detention basin is surrounded by single family residential property on the north and west boundaries. Within this area are a junior high school and Thomas Park, a local neighborhood park. On the east boundary is industrial property. To the south are county-owned property and facilities, which include a Department of Motor Vehicles, Juvenile Detention Center, Country Hospital, and a Communications Center.

Ajo Way and County Club Road, which are two-lane streets in each direction, are the main transportation corridors to the project site. Interstate 10, one mile to the south, is a major regional and state transportation route.

From a regional land use standpoint, the detention basin is located in what is termed "the core" of Tucson. The pattern of growth in this area is relatively stable. The suburbs to the south, southwest, and southeast of the basin are growing and expected to continue growing.

4. Economic Factors. Several economic factors play a significant role in the recreation planning of all projects.

The rate of inflation and concomitantly rising construction costs are reducing the spending power of available funds. It is necessary to plan and construct new facilities expediently.

The increasing costs and uncertain availability of gasoline will reduce willingness to travel to recreation facilities, It is therefore important to develop facilities close to urban populations.

5. Recreation Trends. Participation in all forms of outdoor recreation activities has been growing in the Tucson region.

Some of the significant trends in recreation include the following:

- Increased numbers of senior citizens and a growing need for recreation and social opportunities that are tailored to their interests.
- Increased participation of women in all forms of recreation.
- Increased participation by the physically and mentally handicapped. It has been estimated that there are 18,000 physically handicapped persons in the metropolitan Tucson area.

• A need for recreation opportunities for the teen and preteen-age groups. The people of Tucson believe that recreational opportunity may help reduce crime rates and keep these children out of trouble.

• Recreation activities of a cultural and educational nature are becoming increasingly popular among people of all social and economic levels.

• Increased participation in new or nontraditional activities such as hang-gliding, roller skating, racquetball and volleyball.

6. Recreation Demand. Pima County and the City of Tucson have joined in a comprehensive planning effort to meet the growing recreation demand of the area. This effort has been summarized in the planning document "Parks, Recreation and Open Space: A Conceptual Plan," that was prepared in June 1978 (Briscoe, Maphis, Murray, Lamont, Inc. Key/Fletemeyer Assoc.).

This report indicates that recreation demand in this area is growing at an unprecedented rate. In 1977 nearly 80 percent of the households surveyed participated in outdoor activities. This participation has been increasing at an annual rate of 10 percent, over three times the population growth rate. This rate is expected to increase fourfold by the year 2000.

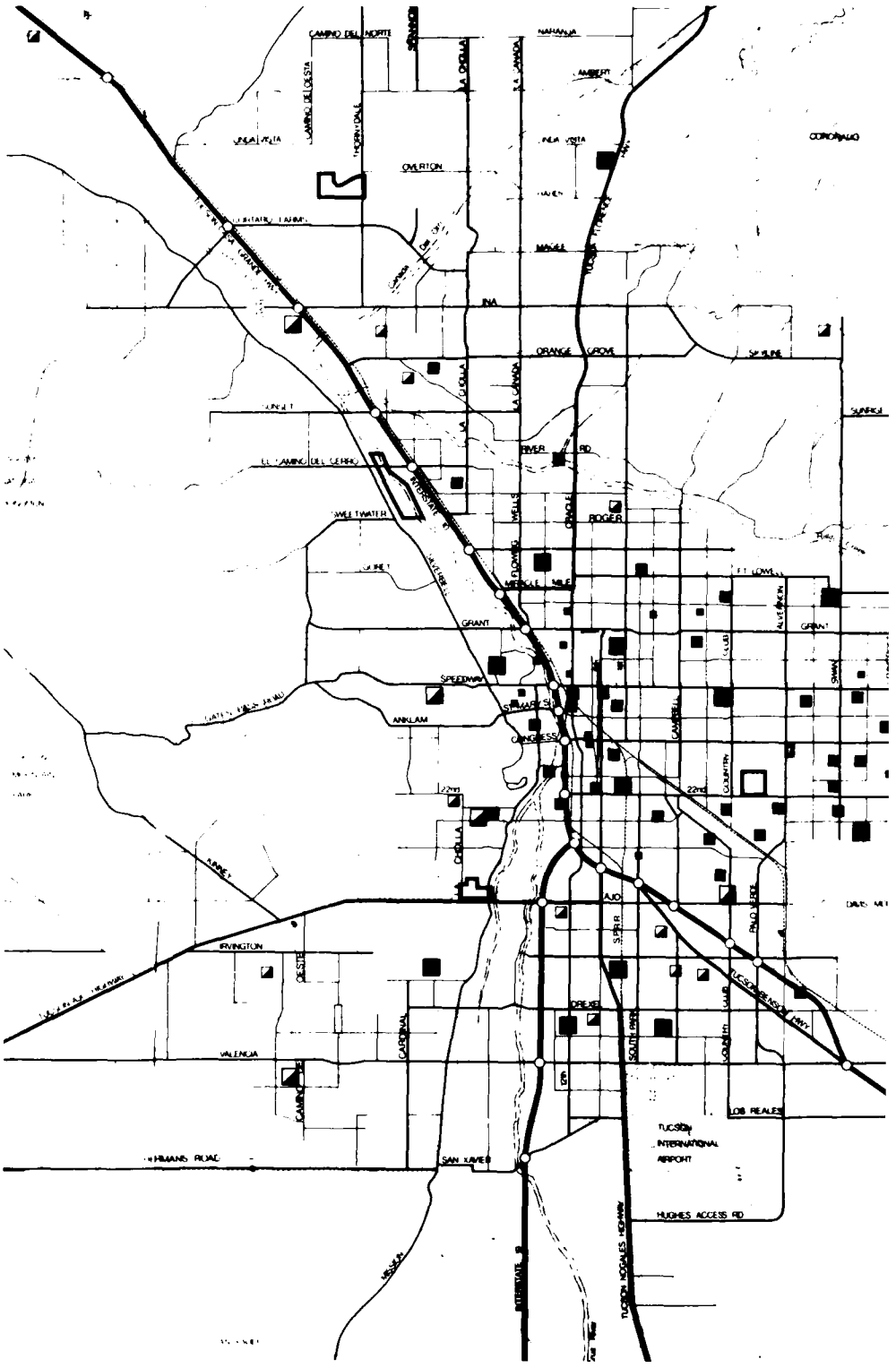
The city and county presently provide more than 80 free parks and recreation areas. (See plate 2.) Most of these facilities are urban-oriented neighborhood parks (5 to 14 acres). Certain parks within the system serve district (15 to 100 acres) and regional (over 100 acres) needs.

Lake recreation is in short supply and in high demand for Tucson. Kennedy Park (3½ miles east) and Lakeside Park (6 miles west) provide lakes of approximately 12 surface acres. Kennedy Park is not capable of serving a total regional park function because of its limited space for active recreation. Pena Blanca Lake, located 60 miles to the south, has 45 surface acres, with only small motor boats and nonpowered boats allowed. The most popular lakes are Roosevelt Lake and San Carlos Lake, which are a two- to three-hour drive from Tucson.

Based upon the findings of the 1978 county-city plan, recommendations for future parks emphasize a pattern of larger parks that serve district and regional needs. Larger parks can offer a greater diversity of activities and therefore attract more visitors. Capital improvement and operational costs are relatively smaller in larger parks.

The development of additional regional parks is required to meet 1985 and year 2000 population projections. The 1978 plan recommends that the city and county develop two additional regional parks by the year 1985. The heavy use of Reid Park (3 miles west of the proposed project site) was a decisive factor in this recommendation.

Design criteria for future regional parks was also considered. It was suggested that 50 percent of the land area in each park be devoted to unstructured open space containing turf or native landscape.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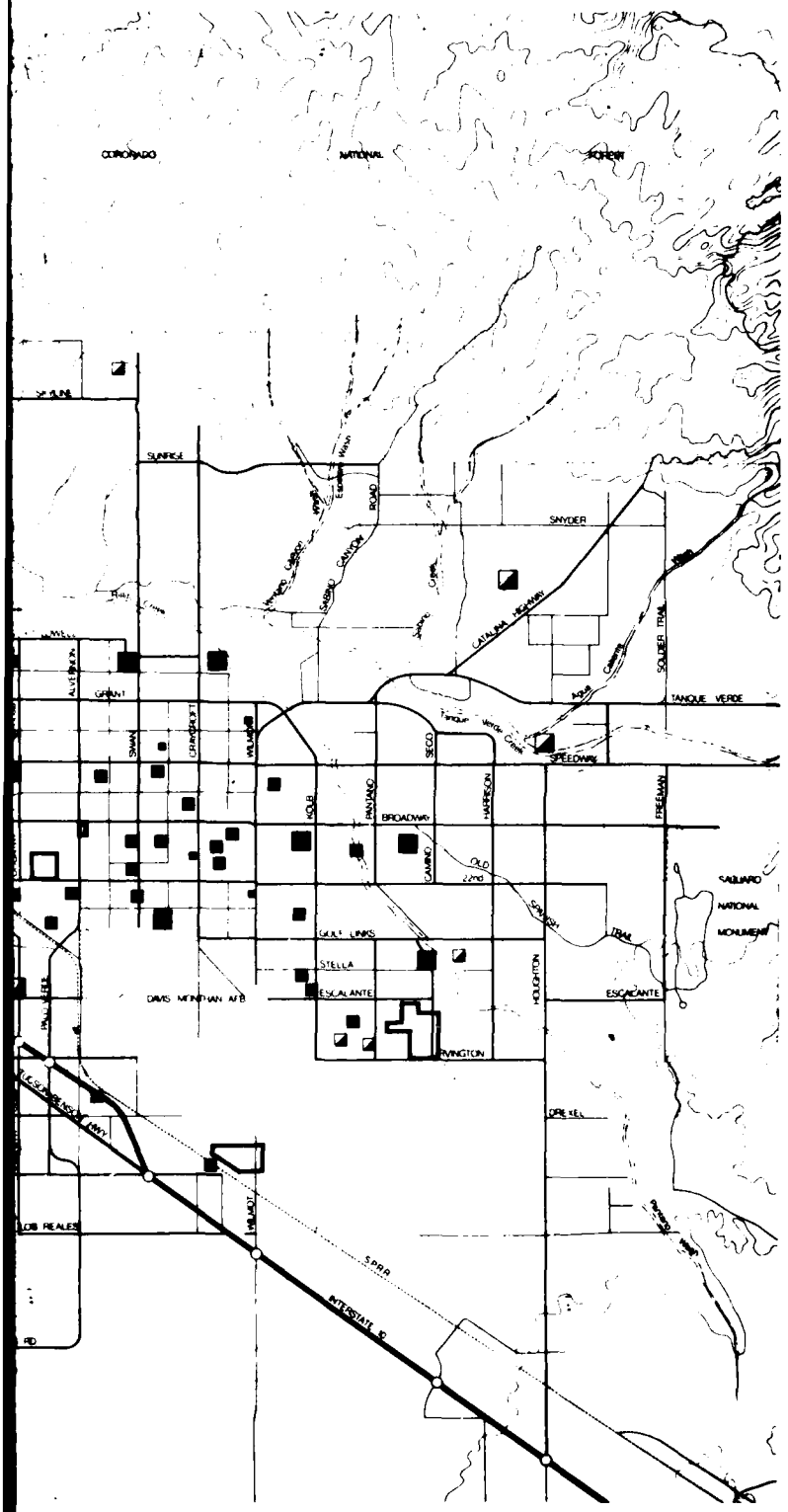

Facility	Developed	Undeveloped
Mini Park	■	◪
Neighborhood Park	■	◪
District Park	■	◪
Regional Park	▬	▬

GILA RIVER and TRIBUTARIES ARIZONA and NEW MEXICO

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EXISTING PARKS

PLATE 2

Needed park features also include such special interest areas as zoos, museums, botanic gardens, water attractions, and water-oriented recreation. Extensive picnicking facilities in high quality environments are also needed.

Each park should be able to accommodate large group activities and have adequate on-site parking. Also needed are facilities for the preteen and teen age groups, bicycle and equestrian trails, and areas for organized team sports. For example, there is an acute need for soccer fields, the emerging demand for which exceeds the existing park system's supply of open fields.

7. Competing Regional Parks. At present six parks within the City of Tucson and Pima County Park System offer regional park facilities. Three of these parks, Section 33, Arthur Pack, and Silverbell Park, are not entirely developed. None of the existing regional parks offers a water-based recreation opportunity the size of the proposed detention basin project. Kennedy Park offers lake recreation, but the lake contains only 12 surface acres. Silverbell Park, which is under construction, will have 15 surface acres.

As for dryland recreation, Reid Park offers the widest diversity of recreation facilities. Its actual park area, not including the golf course and ball fields, is frequently overcrowded, and its expansion is planned so as to serve inner city needs. Kennedy Park, while offering water-based recreation, is limited in its dryland active use areas. Much of the park land is devoted to natural areas. The Thomas Jay Park is a special-use park whose main attraction is an air museum. It was never designed to serve a wide variety of regional park needs.

8. Potential Visitation. The proposed Tucson Detention Basin is designed to serve the entire metropolitan Tucson area. Its service area population is 502,700 (1978). Annual visitation for the facilities is projected to be 66,240 persons after initial development of Phase 1; and 324,000 persons five years after completion of Phase 2.

C. Resource Base Summary — *Opportunities and Constraints.* The Tucson Detention Basin is located in the rapidly growing Tucson metropolitan region. Its mild desert climate has attracted its share of sun belt migrants and recreation enthusiasts. As a result of the growth, Tucson faces a critical ground water overdraft problem. Because of new growth, precious water resources can no longer be justified for recreation lakes or esthetic purposes. Alternate sources such as reclaimed water are considered more appropriate for these uses, which are much in demand.

The detention basin is a manmade flood control facility that serves its primary function well. It is also a potentially valuable recreation resource: its original excavation produced large expanses of flat land, suitable for a variety of purposes. Moreover, it is screened from street-generated noise by the 20-foot levees that surround the basin. There is good access from Ajo Way and Country Club Road Highway I-10, only one mile to the south, will accommodate regional and tourist traffic.

The basin is located adjacent to county-owned land. A hospital, Juvenile Detention Center, Department of Motor Vehicles, and Communications Center are located there and more facilities are planned. The entire area has the potential to become a major county facility-regional park entity, in which the various land uses could complement each other.

The Detention Basin now contains an abundance of beautiful native vegetation, which serves as rich wildlife habitat and provides scenic and spatial diversity with its varied form and color. The shade canopy of the trees is also a special recreation resource in the hot desert environment.

The demand for all forms of recreation, especially water-based and active sports areas, far exceeds the local agencies' existing facilities. They estimate that they will need to build two additional regional parks to meet 1985 demand.

D. Resource Use Objectives. The goal of proper resource use objectives is to match the available resources with the existing and projected recreation demand of the area involved. Mitigation measures to be used in case of adverse environmental impacts are also included in these objectives. The resource use objectives for the detention basin are summarized below.

In the preceding chapter, an evaluation and inventory have been made of the environmental, social, and recreation factors that will influence the development proposed at Tucson Detention Basin. The following resource use objectives have resulted from that evaluation.

1. Basic Objectives.

- To maintain the Detention Basin's primary purpose as a flood control facility by designing and constructing recreation facilities that do not decrease its efficiency or capacity.
- To maintain and enhance the basin's existing biological resources and at the same time to develop compatible recreation facilities.
- To develop a multiuse recreation facility that will provide a diverse array of recreation opportunities and attract more users.

2. Resource Use Goals.

- To provide a park and recreation facility that is in harmony with the desert environment. The desert climate is one of the factors most conducive to enjoyable recreation. Its mild winters and hot summers permit year-round participation. But its climate also presents some obstacles; scarcity of water and extreme heat make traditional grass-and-tree parks popular, but difficult and costly to maintain. The water issue is the most sensitive environmental issue associated with the project. Tucson already faces a severe groundwater overdraft problem. The citizens will not allow groundwater to be used for the proposed lake. An alternative source, reclaimed waste water that has been treated to meet EPA standards, will be the lake's water supply. It is a necessary adaptation to a critical environment constraint. Other proposed park facilities requiring fresh water, such as playing fields, trees, and restrooms, will be designed to be water-efficient.

- To utilize and preserve the basin's natural resources, especially vegetation and wildlife habitat, and incorporate them into the final project design. The existing vegetation constitutes a valuable recreation resource. Native species such as mesquite, palo verde, and tamarisk have survived and flourished with available storm runoff. The trees provide shade and shelter for the existing wildlife and could also allow limited passive recreational use.
- To develop the facilities that will be subjected to more intensive use on areas that are free from hydraulic constraints. The area adjacent to the inlet structure will have the most severe hydraulic constraints. A levee will be built to convey nuisance and low flows around the active use areas, and divert them into the nature area. Here the water and sediment deposits will cause little damage or maintenance problems, while supplying moisture and nutrients to the plants.
- To develop intensive use facilities in areas that have been heavily disturbed in recent years. The county highway department has extracted large quantities of sand and gravel from the northeast portion of the basin. Large spoil heaps remain. This area will need regrading to make it usable. Therefore the most extensive grading and development are proposed for this sector.
- To develop a master plan that allows flexibility in design. The proposed development is designed to be constructed in two phases due to financial limitations. But it has been designed to be a viable park facility regardless of how many phasing options are ultimately exercised.

3. *Objectives Related to Land Use Allocation.* The basin has been designed as a multiuse facility that will provide a diverse array of recreational opportunities from the very active to the very passive. The bicycle and hiking trail will circle the basin and link all use areas.

Active use areas are proposed for the southeast portion of the basin, in close proximity to the access road and parking areas. The following facilities will be constructed in this area.

- A large group picnic area with barbeques and overhead ramadas. Large group picnic facilities to host civic group get-togethers such as Kiwanis Club Pancake Breakfast. These facilities will be located near a restroom and a number of active sports facilities.
- A spectator-seating area for athletic events. A limited section of the levee walls will be reconstructed to provide a large spectator seating area. This will allow for audience participation in the field events below. The proposed seating will face the northeast, to minimize sun angle problems for the spectators.
- Multiuse fileds designed for soccer, football, and baseball will be located below the seating area.
- An exercise and fitness trail will be provided for use by both the able-bodied and the handicapped.

Moderate to heavy uses can be provided in connection with the development of the 60-acre recreation lake, as follows.

- A 60-acre boating and fishing lake will be excavated at the basin's lowest elevation. The lake will be zoned for boat activity that ranges from active (motor) to passive (sail).
- Lakeside picnic areas as well as riding and hiking trails will be built to complement the adjacent water activities and exploit good views.

- A boat-launching and fish-cleaning area will be developed in connection with the other lake-oriented activities. Access to the boat launch area will be designed so that it does not interrupt circulation through the rest of the park.

Quiet restful areas will be provided in isolated pockets throughout the park, but located so as to permit views of the more active areas, if desired.

- Family picnic units will be located near the lake. Barbecue grills and picnic ramadas will be located within a relatively short walking distance.
- A nature area will be reserved primarily for its value as wildlife habitat. Minimally developed pedestrian trails will also be provided for wildlife observation. This area will provide a floral backdrop on the north side of the lake.

3. The Plan

A. Existing Recreation Use of Tucson Detention Basin. Presently no public access is permitted to the detention basin. A chain link safety fence has been constructed around the project to discourage entry.

B. Proposed Recreation Development. Recreation development in the Tucson detention basin will occur in two major phases: (1) creating dryland recreation facilities; (2) subsequent construction of a 60-acre multipurpose lake, waste water treatment facility, and additional dryland facilities (See plates 3 and 4.)

1. Low Flow Channel. In the initial phase of development a low-flow channel will be constructed to convey flows of up to 300 cubic feet per second (cfs) around the multiuse field areas and along the edge of the proposed nature area.

When flows exceed this amount they will move to the western portion of the basin, which is its lowest point. Only native seeding is proposed for this area so that plant life or facilities will not be damaged by inundation.

In the second phase of development, when the low flow is exceeded the flows will go directly into the lake.

2. Dryland Recreation. The initial recreation development will provide for active uses. Picnic facilities, bicycle trails, exercise fitness trails, par course for the handicapped, spectator seating for sports events, court areas, large turfed areas for football, baseball, and soccer, an archery range, and a nature area will be developed. Also during Phase 1 a paved access road, parking areas, comfort stations, and service roads will be constructed.

Once the local sponsors deliver the required quantity and quality of water, a 60-acre multipurpose lake will be developed, and used for boating and fishing. A water treatment facility is a significant feature of the second stage of development. A 10-acre site in the northeast corner of the basin has been set aside for this facility. Land treatment will be used to bring the water supply up to Environmental Protection Agency (EPA) recreation standards. The water will be pumped from this facility directly into the lake.

Additional dryland facilities will be developed in conjunction with the multipurpose lake development. The bicycle and hiking trail will be expanded around the lake's edge. Additional picnic areas will be developed adjacent to the water-related activities area. A boat dock and fish-cleaning area will be part of the lake edge development. An additional restroom will be constructed to accommodate visitors to the lakeside area.

C. General Water Supply Concept. Water for the lake will come from a combination of treated effluent and ground water. The proposed concept involves the use of ground water or treated effluent for the initial filling of the lake. Treated effluent will then be used to maintain its water level.

The existing secondary treatment plant now produces 65 percent of the monthly summer water requirement for Randolph Park and 300 percent of the park's monthly winter water requirement for Randolph Park (for irrigation of its golf course). Groundwater drawn through city mains provides the additional water needed during the summer months.

The Randolph plant is currently treating approximately 1.0 mgd. By constructing a lift station to bring in additional effluent, the plant's capacity will be raised to 1.5 mgd. Then by tertiary treating this effluent, enough water will be obtained to maintain a 60-acre recreation lake.

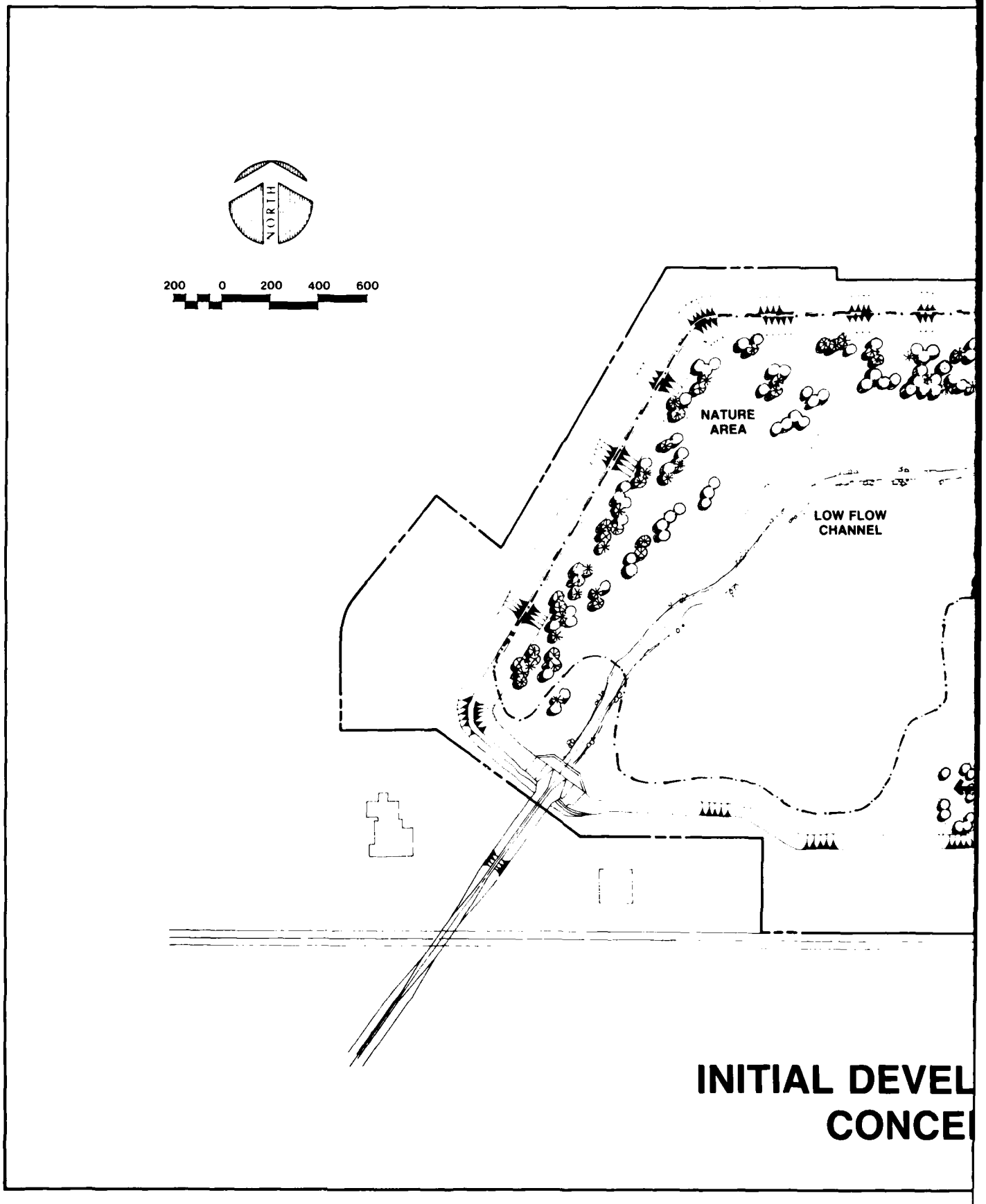
D. Water Treatment Concept. As a result of the feasibility study made by Rod Gomez and Associates in November 1979, the quantity and quality of the secondary effluent from Randolph Park plant were further analyzed. The study also investigated alternative methods to treat the effluent to meet EPA quality standards for recreation use. The study determined that the most economically feasible method was land treatment. Simply stated, this method involves percolating the effluent through a porous soil medium to remove the undesirable elements and then pumping the cleansed water to the surface for use.

A comparison of the physical and chemical properties of the Randolph Waste Water Treatment Plant effluent with the water quality standards established by the Arizona Department of Health Services for recreation use is in Appendix D.

When the effluent reaches the project site it will be spread over a 10-acre area. This 10-acre parcel will have been excavated to a depth of 15 feet, an impermeable lining spread over the area, and drains placed over the lining before the soil is put back in place. Then, the effluent percolates through the 15 feet of soil. Bacteria, nutrients, and microorganisms are filtered out as the water moves through. The water is then pumped back to the surface for use in the lake. (See fig. 3.)

Maintenance costs for this system are relatively low. One maintenance feature of this process is that the area must be allowed to "rest" for several weeks annually. This is not a problem because during the summer months no effluent will be applied to the soil.

Land application does not effectively remove ammonia, however. An ammonia-stripping unit must be built at the existing plant to treat the water before it is released to the project site. Local agencies would pay the cost of installing the equipment.



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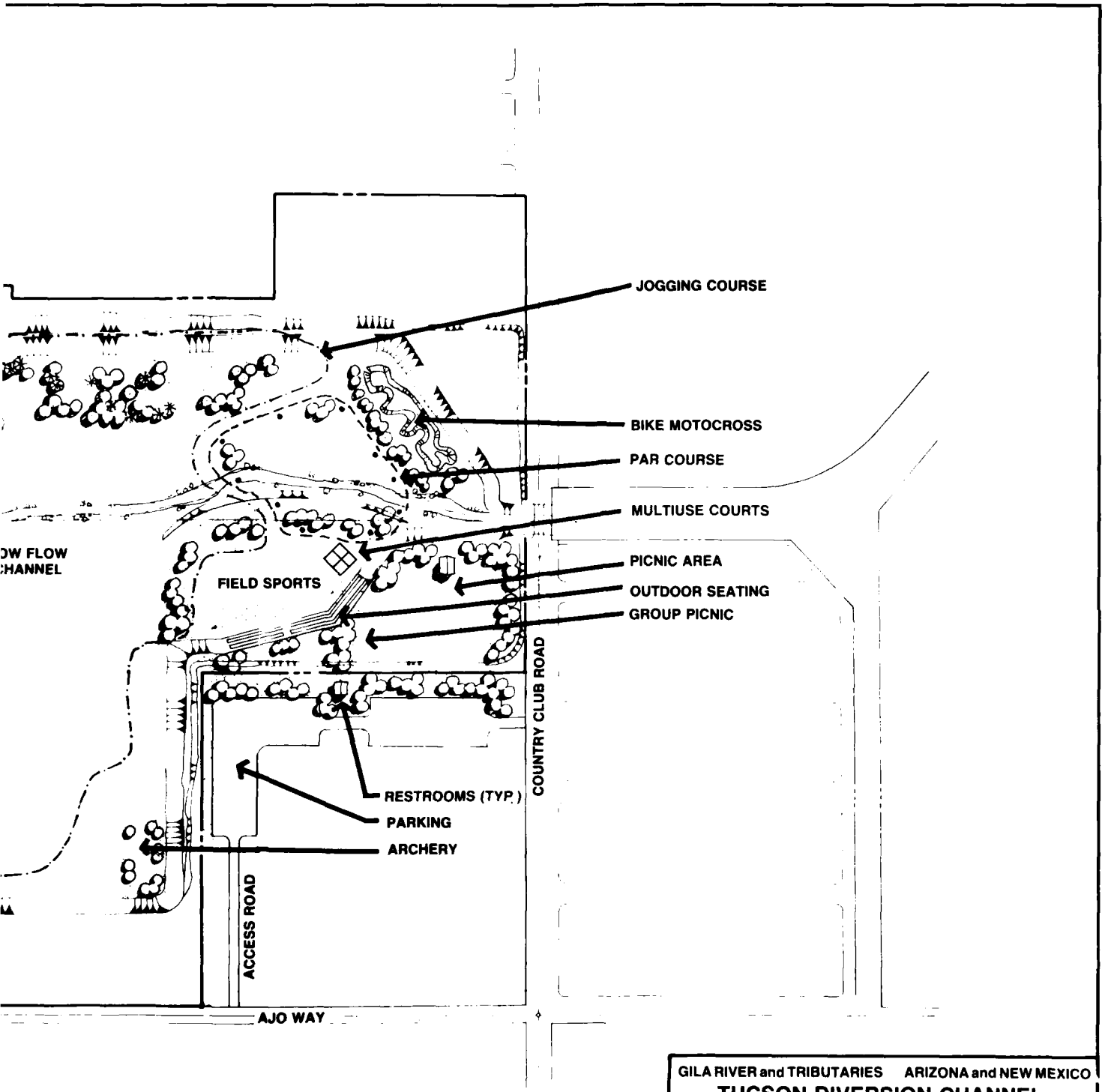

. DEVELOPMENT CONCEPT

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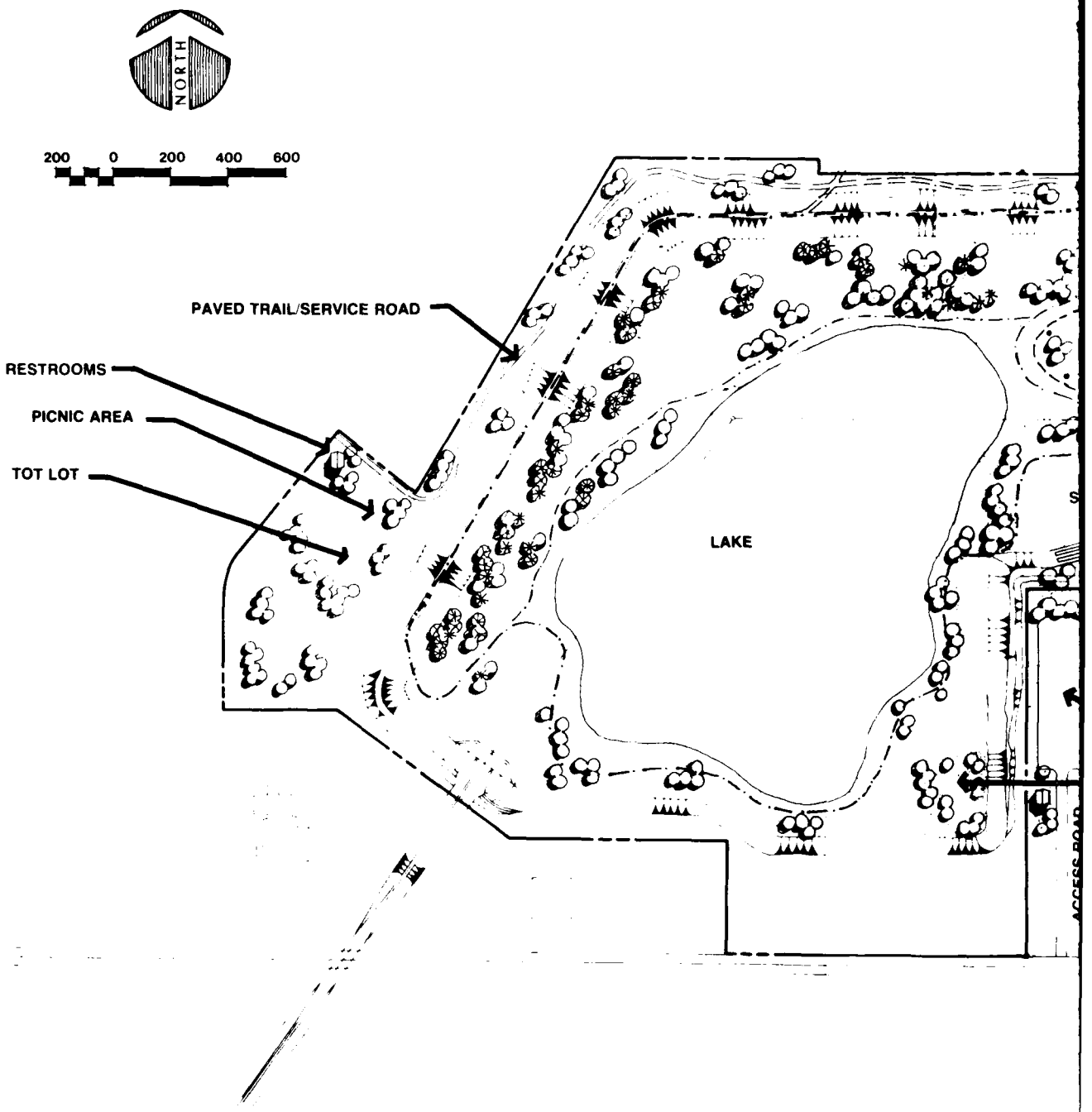
RECOMMENDED PLAN FOR RECREATION PHASE 1.

PLATE 3

7



ULTIMATE DEVELOP
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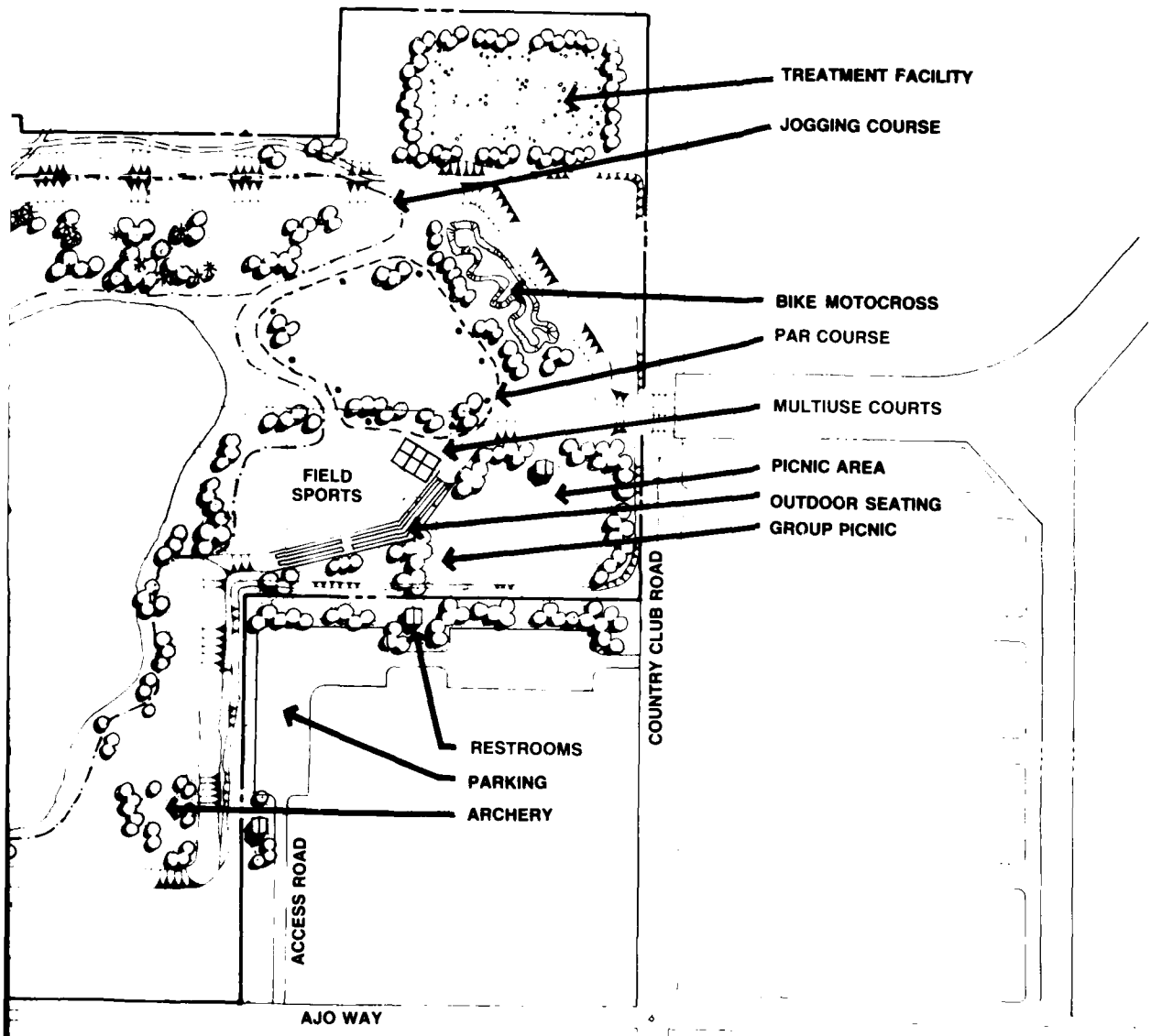

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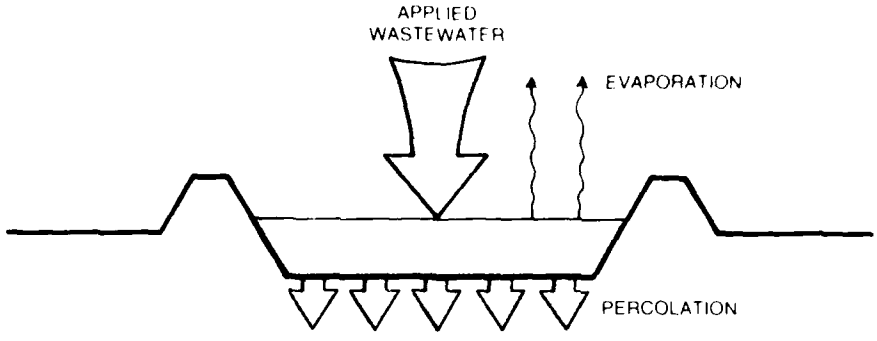
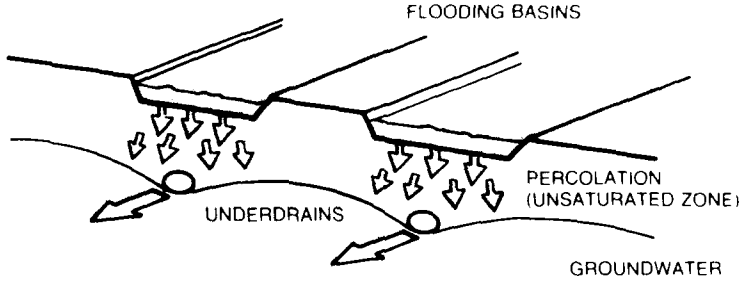
RECOMMENDED PLAN FOR RECREATION PHASE 2.

PLATE 4

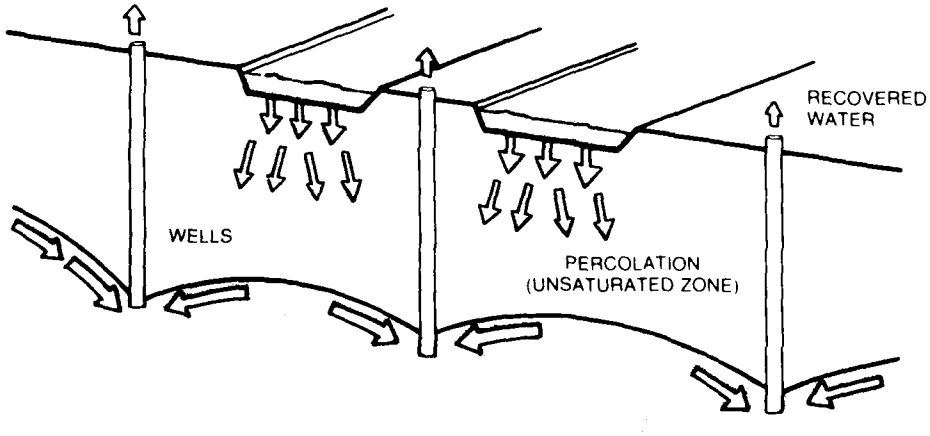
7



(a) HYDRAULIC PATHWAY



(b) RECOVERY OF RENOVATED WATER BY UNDERDRAINS



(c) RECOVERY OF RENOVATED WATER BY WELLS

Figure 3. Land Infiltration Diagram.

E. Storm Water. The characteristics of the storm water entering the basin will vary considerably, depending on the time of the year and quantity of flow. Storm water occurring after a considerable dry period will contain a greater concentration of pollutants than will storm water occurring later in the year. The exact characteristics of the storm water have not been measured, but it is assumed that the major concentration of pollutants would be the first flow to enter the basin.

The proposed plan calls for storm water from rainfall of low intensity to be routed around the lake by the proposed low flow channel, and storm water with rainfall of greater intensity would flow into the lake and be flushed out by ensuing flows. Any pollutants left behind would be diluted by the remaining water in the basin

F. Cost Shareability of Project Features. The following determination of the cost shareability of proposed project features is based on the Veysey Guidelines, dated 23 February 1976.

1. Lake. The multipurpose lake is a cost-shareable project feature. In addition to serving as a recreation lake, the lake would be designed to provide wildlife habitat for migratory and native bird species.

2. Tertiary Treatment Facility. Under the Code 710 cost-sharing program, the treatment facility is cost-shareable because it is required for the recreation lake's water supply and quality. This proposal is consistent with ER 1110-2-400, dated 13 Sept. 1974, and with Veysey Guidelines. Only those portions of the treatment facility built on project lands will be cost-shareable, however. The local sponsors will assume 100 percent of costs for facilities outside of the project boundary.

3. Incoming Line. Under the Code 710 cost-sharing program the incoming line can be cost-shared.

4. Land Acquisition. The 40-acre land acquisition is not a cost shareable item. There are no Code 710 funds available for land acquisition in FY 1980.

5. Access, Parking, Comfort Station, and Upper Picnic Areas. These facilities have been located on the north and west portions of the county-owned property. It was necessary to place these on county property because of (1) the limited available land in this part of the project site; (2) because of the hydraulic constraints near the inlet, and (3) because the major access points into the project are from Ajo Way and Country Club Road. These items are cost-shareable according to Veysey Guidelines dated 23 February 1976.

6. Other Project Features. All other features of the proposed plan are cost-shareable items, including the picnic facilities, restrooms, access roads, multiuse fields, multiuse courts, spectator seating area, bicycle trail, parking areas, lighting, and landscaping.

G. Planning/Design Criteria. Planning criteria for Code 710 development is to be in accordance with ER 1120-2-400, "Investigation Planning, and Development of Water Resources — Recreational Resources Planning." Detailed design criteria is to be in accordance with ER 1110-2-400, "Design of Recreation Sites, Areas and Facilities," and ER 1110-1-102 and EM 1110-1-103, "Design for the Physically Handicapped." Design and construction under the Code 710 program is to adhere to local building requirements and, in some cases, reflect stricter Corps standards.

H. Proposed Development Schedule. The proposed recreation facilities will be constructed in two phases. If this master plan is approved, construction of Phase 1 facilities will begin during FY 1981. Phase 2 facilities will be developed under the Code 710 cost-sharing program only if both local and Federal funds are available.

I. Facility Development. The recreation and support features of the proposed development have been broken down into phased development. These phases are outlined in the following paragraphs and are shown on plates 3 and 4.

1. Phase 1.

a. Low-Flow Channel. A low flow channel will be built along one side of the nature area. The channel, which will have a maximum height of about 4 feet, is to be capable of routing 300 cfs from the inlet channel to the outlet channel. The channel design will follow the guidelines set forth in EM 1110-2-1913, dated 31 March 1978. After Phase 1 development, flows in excess of 300 cfs will drain into the native seeded area at the west end of the basin. After Phase 2, excess flows will empty directly into the lake. Native landscaping and rocks and boulders will be incorporated into the design of the low flow channel to give it the appearance of a natural stream bed.

b. Access Roads. There will be two vehicular entrances to the proposed site: a south entrance from Ajo Way and an east entrance from Country Club Road. A single, 2-way, 24-foot-wide asphalt cement access road will reach all recreation areas in the basin. The access road, which will have asphalt curbs and gutters, will be designed in accordance with Department of the Army TM 5-887-1, Chapter 1, "General Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas." Secondary gravel service roads will be provided within use areas, as needed, but will not be for public vehicular use. About 2000 feet of roadway will be constructed under initial development, and an additional 500 feet of roadway will be constructed under Phase 2 development.

c. Parking. Under ER 1110-2-400, a single 10- by 20-foot parking space will be provided for each picnic site. These standards meet the local agency's standards for parking lot development. A number of parking spaces will be designed for use by the handicapped. A total of 400 parking spaces will be provided under Phase 1 development: 50 individual street stalls, 250 individual pull-in stalls, and 100 car-trailer combination parking stalls. An additional 100 individual pull-in stalls and 5 handicapped stalls will be provided under Phase 2 development.

d. Paved Trail/Service Road. An 8-foot wide asphalt cement riding and hiking trail will be an integral part of the circulation system of the proposed project. The trail will also act as a service road for park maintenance. So that pleasurable bicycling and hiking will be maintained throughout the park, the trail will not exceed a grade of 15 percent. Total length of the completed trail will be 5,000 feet.

e. Restrooms will be located throughout the site and will be easily accessible from parking and picnic facilities. Their design will reflect the southwestern architecture style. Natural materials will be used for esthetics, low maintenance, and antivandalism qualities. The criteria used to estimate quantities and locate facilities are within the parameters set forth in ER 1110-2-400. Two restrooms will be constructed under Phase 1 and one under Phase 2 development.

f. Group Picnic Area. Ten group picnic tables and five group picnic ramadas are proposed. This group picnic area will seat up to 250 people.

g. Family Picnic Areas. In the family picnic areas there will be a maximum of 10 picnic tables per acre. Picnic facilities will be scattered, or clustered, throughout the park area and around the lake. All of the tables will be designed for use by the handicapped. Barbecue grills, trash receptacles, and drinking fountains will be provided. A total of 10 group picnic tables, 10 family picnic tables, 20 grills and refuse containers, and 10 drinking fountains will be placed throughout the park under Phase 1. A total of 15 picnic tables, 7 grills and refuse containers, and 5 drinking fountains will be added under Phase 2 development.

Shade ramadas with individual table, barbecue grill, refuse container, and drinking fountain will be provided throughout the recreation area. The design of the ramadas will reflect the southwestern architecture style. A modular construction concept that minimizes construction costs will be stressed. Seven shade ramadas will be constructed under Phase 1 and five under Phase 2 development.

h. Spectator Seating. A combination slope and terrace turf area will be incorporated into the levee walls. These areas can seat over 500 people and will be constructed according to Corps standards. From these areas, the spectators may watch activities on the multiuse fields, fitness trails, multiuse courts, and lake.

i. Multiuse Fields. Soccer, baseball, football, and frisbee are among the many uses of this grassed area. A running track is proposed to encircle the field immediately below the seating area, to accommodate track and field events.

j. Fitness Trails. An exercise and fitness course is proposed for the outside edge of the multiuse field area. This trail will be 0.5 mile in length, designed so that one segment of it can be used by the handicapped.

k. Bicycle Motocross. Within the creosote and baccharis shrubs on the northeast side of the park, a series of hills and jumps will be constructed to function as a bicycle motocross. It can be used by individuals or in conjunction with competition events.

l. Archery Range. Archery facilities for field and target archery will be provided in the west end of the basin, where there will be minimum contact and conflict with other uses.

m. Landscaping. Native and drought-adaptive trees and shrubs will be used as landscape elements. A plant palette, consisting of mesquite, palo verde, tamarisk, smoke tree, ironwood, poplar, and some species of eucalyptus, is proposed. These trees will provide a visual continuity with the existing vegetation.

n. Irrigation System. Spray and flood or drip irrigation systems are proposed. The drought-adaptive tree species will be on a drip system, while the field areas will be watered with flood or spray irrigation.

o. Electrical and Lighting. Security lighting will be provided at all recreation buildings and facilities. Lighting will also be installed along walkways and at parking lots. The bicycle trail will not be lighted, but lighting is proposed for the multiuse fields for night use. Wiring will be placed underground, and connections will be made with existing municipal distributions. About 75 percent of the electrical work and lighting will be completed under Phase 1; the rest will be completed under Phase 2.

p. Multipurpose Courts. Basketball, tennis, and volleyball courts, along with shuffleboard, and horseshoes areas are to be located adjacent to the multiuse fields.

2. Phase 2.

a. Lake. The lake will function primarily as a flood control facility, intercepting and dissipating flood flows from the Tucson Arroyo and Railroad Wash drainage areas. The lake will have a surface area of about 60 acres; depth of the lake will vary as necessary to provide advantageous habitat for fish and wildlife, but will average about nine feet. The lake will be used for boating and fishing; swimming will not be permitted. Proposed facilities will include a boat-launching ramp and a fish-cleaning area. The embankment for the lake will be equipped with both an inlet and an outlet structure. During floods, the outlet structure will be capable of emptying the basin as fast as it does now. The lake, the embankment, and the inlet and outlet structures will be constructed during the second phase of development.

b. Treatment Facility. A 10-acre parcel of land in the northeast corner of the project will be utilized for a land application water treatment method. For a detailed description of the facility see Chapter 2, A.5. and Chapter 3, C.

c. Lakeside Picnicking. Family and group picnic facilities are proposed along the lake shore. These are to include picnic ramadas, barbecue grills, and trash receptacles.

d. Restrooms. Additional restrooms will be built to accommodate lakeside visitors. They will be located above the 100-year flood elevation.

e. Landscaping. Additional landscaping, utilizing the same plant palette described in preceding paragraph H.1.m., will be installed in the second phase. The lake edge will receive the most extensive landscape treatment.

f. Irrigation. Additional irrigation is proposed for the landscaping in the second phase of development.

g. Lighting. In the second phase, lighting is proposed for the bicycle and hiking trail along the lake edge.

4. Special Problems

There are a few special problems that will need to be resolved so the recreation resources of the Tucson Detention Basin can be fully developed.

A. Construction Costs Associated With Phase 2 Lake Recreation Development. The District, and Pima County Parks and Recreation people are well aware that the construction costs presented in Chapter 6 exceed the recommended benefit cost ratio. The Corps recommends that Phase I dryland recreation be approved as presented, and the Phase 2 lake development be approved in concept only.

The construction costs presented in chapter 6 do not reflect the following possibilities that could substantially lower future costs for Phase 2 lake development:

- Potential market value for borrow material from lake excavation. Costs for lake excavation could be lowered or eliminated if the borrow material were exchanged for lake excavation work.
- Discussions with Metropolitan Utilities Management staff indicated that requests have been made to have Randolph Park treatment plant increased in capacity. (CBEA Feasibility Study, January 1976). A viable consideration to meet the needs of the city as well as the county, would be addition of phosphorus removal, sand filtration and chlorination. It would reduce or eliminate the need for a tertiary treatment facility at the lake site.

If and when the lake development becomes economically justified an additional feature design memorandum would be prepared describing the lake's construction.

B. Alternative Design Options for Phase 2 Recreation Development. The master planning process has carefully considered design options for the second phase of recreation development. In the event that Phase 2 lake development is not implemented because of prohibitive costs, a viable dryland regional park can be expanded. Phase 1 recreation development has anticipated this possibility in its design. This alternative is also supported by the local sponsors of the project and state and local recreation studies which indicate a need for additional dryland facilities in the Tucson metropolitan region.

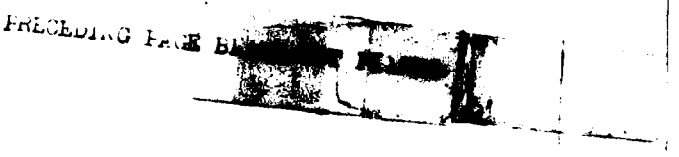
5. Agency Coordination and Public Involvement

The Corps of Engineers, the Pima County Parks and Recreation Department, and representatives of the City of Tucson met with the general public and representatives of interested agencies and groups to discuss the feasibility of developing a multipurpose recreation/wildlife lake in the Tucson Detention Basin. These meetings were held on 21 and 29 September 1977 and on 17 November 1977, in Tucson, Arizona.

At these public meetings, the proposed plan developed by CBEA was described and discussed. The public was informed that the Corps will continue to study the original feasibility plan and, through this present master plan, determine its feasibility; will develop an array of possible alternatives (i.e., lake size other than 60 acres); will address concerns regarding ground water use, evaporation rates, envirionmental factors (e.g., suitability of the water as fish habitat); and will develop cost estimates for the project proposed by CBEA.

During ongoing studies, the District will continue to stress the need either to reduce the present ground water requirement of the proposed plan or keep it at its present level. The District will also be looking at ways to make the proposed lake a viable fish habitat. Various methods of creating a wildlife habitat (e.g., by creating an isolated shoreline along one side of the lake) will be investigated.

The Corps will continue to involve the public in this planning process.



6. Cost and Recreation Benefit Estimates

A. Cost Estimates. The Board of Supervisors of Pima County has indicated a willingness to enter into a cost-sharing agreement with the Corps of Engineers to secure construction funds for the proposed recreation development. A three-year program and associated annual cost estimates were discussed with Corps representatives and subsequently outlined in two Letters of Intent, dated 2 June 1976 and 9 September 1976.

As a result of the Rod Gomez and Associates Feasibility Report, dated November 1979, costs for the initial development have since been reestimated. A lake development could not be constructed with the funds that the local agency allocated in its 1976 Letters of Intent. The Corps has therefore recommended a two-phase program. Dryland recreation will be constructed in the first phase. Then the 60-acre lake, treatment facility, and additional dryland recreation development will be constructed under Phase 2 development. The Board of Supervisors has examined this change in phasing and has approved the revised concept.

Under the Code 710 program, the Federal Government and Pima County, Arizona, will share the cost of developing those features that have been determined to be cost-shareable items. Estimated Federal and local costs for each phase of development are shown in tables 1 and 2.

Table 1. Estimated Cost of Phase 1 Recreation Development.

Item No.	Description	Estimated Quantity	Unit	Unit Cost	Total Cost
1.	Group Ramadas. 38' x 32'	5	Each	22,600	113,000
2.	Picnic Ramadas. 19' x 16'	10	Each	9,000	90,000
3.	Group Picnic Tables (precast conc. 20' x 3' x 4" with conc. benches)	10	Each	1,022	10,220
4.	Picnic Tables (precast conc. 10' x 3' x 4" with conc. benches)	10	Each	682	6,820
5.	Restrooms, 26' x 34'	2	Each	40,000	80,000
6.	Multipurpose Courts	1	Job	LS	50,000
7.	Multipurpose Fields	1	Job	LS	50,000
8.	Jogging Trail (graded 4' wide)	1	Mile	1,170	1,170
9.	Grills	20	Each	100	2,000
10.	Refuse Containers	20	Each	75	1,500
11.	Drinking Fountain	10	Each	350	3,500
12.	Parking Facilities	2,200	SY	6.50	14,300
13.	Access Roads, 24' wide	5,300	SY	7.30	38,700
14.	Paved Trail Service Road, 8' wide	4,400	SY	6.50	28,600
15.	Conc. Sidewalk, 8' wide	400	SF	1.50	600
16.	Parking Lighting	10	Acre	4,400	44,000
17.	Park Signs	1	Job	LS	2,000
18.	Trees — 15 gal.	200	Each	75	15,000
19.	Trees — 5 gal.	150	Each	15	2,250
20.	Grading	30	Acre	1,500	45,000
21.	Site Clearing and Grubbing	30	Acre	400	12,000

Table 1 (Continued)

Item No.	Description	Estimated Quantity	Unit	Unit Cost	Total Cost
22.	Turf w Automatic Irrigation	28	Acre	14,000	392,000
23.	Outdoor Seating	1	Job	LS	45,000
24.	Parcourse Stations	1	Job	LS	8,000
25.	Low-Flow Channel 4 ft. high x 10 ft. wide x 2,440 ft. long	3,540	CY	2.25	8,000
26.	Archery	1	Each	3,000	3,000
27.	Tot Lot	1	Each	10,000	10,000
	Subtotal				$1,076,700
	20% Contingencies				215,300
	10% Engineering and Design				129,200
	6% Supervision and Administration				77,500
	Total Construction Cost for Recreation Facilities (Phase 1)				$1,500,000

Note: SY denotes square yards; SF denotes square feet; CY denotes cubic yards and LS denotes lump sum

Table 2. Estimated Cost of Phase 2 Recreation Development.

Item No.	Description	Estimated Quantity	Unit	Unit Cost	Total Cost
	LAKE CONSTRUCTION				
1.	Lake Excavation	800,000	CY	2.25	1,800,000
2.	Excavation Disposal	400,000	CY	1.00	400,000
3.	Lake Seal	1	Job	LS	600,000
4.	Flood Control Structure	1	Job	LS	100,000
	Subtotal				$2,900,000
	Recreation				
1.	Picnic Ramadas	5	Each	5,000	25,000
2.	Picnic Tables	15	Each	250	3,750
3.	Grills	7	Each	100	700
4.	Refuse Containers	7	Each	75	525
5.	Parking Facilities	1,000	SY	6.50	6,500
6.	Paved Trail Service Road 8' wide	4,000	SY	6.50	26,000
7.	Conc. Sidewalks, 8' wide	400	SF	1.50	600
8.	Park Lighting	5	Acre	4,100	20,500
9.	Drinking Fountain	5	Each	350	1,750
10.	Park Signs	1	Job	LS	500
11.	Multipurpose Fields	1	Job	LS	8,000
12.	Tot Lot	1	Each	8,000	8,000
13.	Trees — 15-gal.	100	Each	75	7,500
14.	Trees — 5-gal.	100	Each	15	1,500
15.	Grading	15	Acre	1,500	22,500
16.	Site Clearing and Grubbing	15	Acre	400	6,000
17.	Turf w/ Automatic Irrigation	10	Acre	14,000	140,000
18.	Restroom, 20'x30'	1	Each	20,000	20,000
	Subtotal				$299,300

Table 2 (Continued)

Item No.	Description	Estimated Quantity	Unit	Unit Cost	Total Cost
	Treatment Facilities				
1.	Transmission Conveyance, Force Main 1.5 miles	1	Job	LS	120,000
2.	Transmission - Pumping	1	Job	LS	190,000
3.	Storage Period	1	Job	LS	20,000
4.	Application System Infiltration-Percolation	1	Job	LS	400,000
5.	Under Drains	1	Job	LS	40,000
	Subtotal, Base Date*				770,000
	Trend Factor**				1.85
	Subtotal				1,424,500
	Phase 2 Development				
1.	Lake Construction				2,900,000
2.	Recreation				299,000
3.	Treatment Facilities				1,424,500
	Subtotal				4,623,800
	20% Contingencies				924,800
	10% Engineering and Design				554,900
	6% Supervision and Administration				332,900
	Total Construction Cost For Ultimate Development				$6,436,400

Note: CY denotes cubic yards; LS denotes lump sum; SY denotes square yards; and SF denotes square feet.
* February 1973.
** Trend factor = EPA Sewer Construction Cost Index analysis data at appropriate location ÷ 194.2

B. Recreation Benefits. The determination of recreation benefits for development of the Tucson Detention Basin was undertaken in accordance with the Water Resources Council procedures for evaluation of National Economic Development (NED) benefits and costs. The methodology employed determined both a user-day value for each activity and the number of visitor days annually provided by the project. Full use of the project facilities is not achieved until the sixth year of project operation to allow for a growth in public awareness of project features provided.

1. Benefit-Cost Analysis. The development of overall costs included an anaylsis of the cost of advanced waste water treatment, required for the water-based recreation; cost of recreation features; operation and maintenance for the recreation and treatment facilities; and cost of water used to provide the water-based recreation. Since the treatment facilities will not be necessary without the recreation lake, the total cost of advanced sewage treatment is a project cost. Five factors were included in determining user-day valves for the various recreation opportunities. These include relative scarcity, ease of access, esthetic attraction, extent of facility development and availability of complementing activities.

2. Phase 1. Initial Phase 1 development of the Tucson Detention Basin includes picnic areas, fields, courts, a 2-mile jogging trail, and a 500-seat spectator seating area. Table 3 lists the costs and associated benefits for the Phase 1 development.

3. Phase 2. Phase 2 development includes the construction of additional general recreation facilities, construction of a 60-acre lake, a pumping station to deliver up to 0.5 mgd of additional effluent to the Randolph Park treatment plant, an ammonia-stripping facility, and a tertiary land treatment facility.

The proposed lake will be lined, to prevent effective percolation of water. There will be an evaporative loss of 446.9 acre-feet annually from the lake. There also will be a reduction of groundwater recharge of 416 acre-feet annually as a result of the project. Pumping costs for groundwater in Tucson averages $40 per acre-foot. To provide water for recreation use, the alternative to effluent use is groundwater. Cost for the recreation water supply is $16,600 annually.

Table 4 shows the costs, benefits, and benefit cost analysis for Phase 2 development.

Table 3. Phase 1 Benefits and Costs.
(7⅛%, 100-Year Analysis.)

Project Costs	
First Cost of Recreation	$1,500,000
Annual Cost	106,900
Operation and Maintenance (3% of first cost)	45,000
Total Annual Charges	$151,900

Ultimate Annual Recreation Benefits

Use	Units	Density	Turnover	Factor*	Annual User Days	User Day Values	Annual Benefits
Picnicking (R = 8)	20	7.5	2	96	28,800	2.25	$64,800
Courts	5	4	3	108	6,480	2.00	12,960
Fields	5	10	3	108	16,200	2.05	33,210
Jogging (M = 12)	2 mi.	20	5	135	27,000	1.80	48,600
Spectators	1	500	.1	108	54,000	1.60	86,400
					132,480		$245,970

Average Annual Benefits (Phase 1)

First-year benefits (246,000 ÷ 2)	123,000
5-year maximization factor @ 7⅛%	.820988
Product	101,000
First-year benefits	123,000
Total equivalent annual benefits	$224,000

Phase 1 Annual Benefits	224,000
Phase 1 Annual Costs	152,000
B-C Ratio	1.5
Net Benefits	72,000

Note: $*\text{FACTOR} = \frac{R \times N}{M \times W}$

R = Ratio of duplication (0.9 unless otherwise indicated)
N = Number of weekend days in peak month (9)
M = Proportion of annual recreation visits in peak month (0.15 unless otherwise indicated)
W = Proportion of peak month visits on weekends (0.5)

Table 4. Phase 2 Benefits and Costs.
(7⅛%, 100-Year Analysis.)

Project Costs	
First Cost of Recreation	4,453,500
First Cost of Sewage Treatment	1,982,900
Annual Charges	
Annual Recreation Costs	317,600
Annual Treatment Costs	141,400
Recreation O & M (3% of first cost)	119,000
Treatment O & M	71,200
Annual Cost of Water for Rec. Lake	16,600
Total Annual Charges	665,800

Ultimate Annual Recreation Benefits

Use	Units	Density	Turnover	Factor	Annual User Days	User Day Values	Annual Benefits
Picnicking (R = 8)	15	5	2	96	14,400	2.25	$32,400
Fields	1	10	3	108	3,240	2.05	6,642
Tot Lot	1	5	3	108	1,620	1.55	2,511
Boating	60 ac.	2	2	108	25,920	2.51	65,059
Fishing	60 ac.	4	2	108	51,800	2.45	126,910
Shore Fishing	7000'	04	3	108	90,720	2.00	181,440
					187,700		$414,962

Average Annual Benefits (Phase 2)

First-year benefits (415,000 ÷ 2)	$207,500
5-year maximization factor @ 7⅛%	.820988
Product	170,400
First-year benefits	207,500
Total equivalent annual benefits	$377,900
Phase 2 Annual Benefits	$385,500
Phase 2 Annual Costs	665,800
B C Ratio	.57
Net Benefits	287,900

Note: $^{*}FACTOR = \frac{R \times N}{M \times W}$

R = Ratio of duplication (0.9 unless otherwise indicated)
N = Number of weekend days in peak month (9)
M = Proportion of annual recreation visits in peak month (0.15 unless otherwise indicated)
W = Proportion of peak month visits on weekends (0.5)

7. Cost Sharing Under The Code 710 Program

The Tucson Detention Basin project cost shareable features are summarized in the following table.

Table 5. Phases 1 and 2 Cost Shareable Features.

Description	Federal	Pima County
Phase 1 Development (Cost Shareable Features)	$750,000	$750,000
Phase 1 Development (Noncost Shareable Features)	0	0
Total, Initial Development	750,000	750,000
Phase 2 Development (Cost Shareable Features)	3,218,000	3,218,000
Phase 2 Development (Noncost Shareable Features)		
1. 0.5 mgd raw sewage pumping station		$431,600
2. 0.81 mgd ammonia stripping unit		178,200
		$609,800
Total Estimated Project Cost	$3,968,000	$4,578,000

8. Conclusions And Recommendations

A. Conclusions. This master plan has presented a comprehensive strategy for recreation development at the Tucson Detention Basin. The following conclusions were reached.

- While the detention basin will maintain its primary function as a flood control facility, recreation development can be successfully integrated to provide a valuable recreation resource for the Tucson metropolitan region.
- The planning process utilized in the development of this master plan evaluated and analyzed numerous factors, including hydraulic constraints, economic, social, and biological factors, to yield a feasible development strategy.
- The proposed recreation facilities reflect needs identified in both local recreation planning studies and in the Arizona Statewide Comprehensive Outdoor Recreation Plan.
- The proposed plan will enhance the environmental resources of the detention basin.
- The proposed plan will function well and its maintenance will not overtax environmental or energy resources.

B. Recommendations. The approval of this master plan is recommended for the following reasons:

- The existing flood control basin will now function as a multi-use facility, optimizing the use of a land resource.
- It will help meet the recreation needs of a growing metropolitan area.
- It has been proven an economically viable investment in terms of benefit cost analysis (Phase 1).
- It will serve as a guiding document for the preparation of the Feature Design Memorandum and Plans and Specifications.
- It will also serve as a guiding document in the overall development and management of the Tucson Detention Basin.

APPENDIXES

CONTENTS

APPENDIX A
PERTINENT CORRESPONDENCE

PIMA COUNTY
OFFICE OF THE COUNTY MANAGER
131 W. CONGRESS, 11th FLOOR
TUCSON, ARIZONA 85701
(602) 792-8661

January 18th, 1980

Col. Quinn A. Teague
District Engineer
Department of the Army
L.A. District Corps of Engineers
P.O. Box 2711
Los Angeles, California 90053

Re: Ajo Detention Basin, Tucson Diversion Channel Project

Dear Colonel Teague:

The Pima County Board of Supervisors, at a meeting on Tuesday, January 15th, 1980, approved the concept plan as presented by Mr. Tom Luzano, Project Manager, Corps of Enginners, and Ms. Gail Vanderbie, Corps of Engineers, for the design and construction of a dry park alternate with criteria that water use facilities be included for future incorporation at the Ajo Detention Basin.

It is the County's understanding that the Corps will immediately proceed with hiring an architect engineer for the design of the above project. At the January 15th meeting, the Board of Supervisors also authorized the commitment of $750,000 in existing bond monies for this project, with the understanding that the Corps of Engineers will match $750,000 from their 710 Project, so that this project may proceed as soon as possible.

We appreciate the opportunity to proceed with this project, and your great cooperation in bringing this project to fruition. If you need any further clarifications or assistance, please do not hesitate to contact myself, or Gene Laos, Parks and Recreation Director.

Thanking you in advance for the expeditious handling of this project.

Sincerely,

Craig A. McDowell
County Manager

CAMc:mp

cc: Dennis Majors
Corps of Engineers
Los Angeles District

Gene Laos
Director
Pima County Parks & Recreation

PIMA COUNTY PLANNING AND ZONING DEPARTMENT
PIMA COUNTY GOVERNMENTAL CENTER • 131 WEST CONGRESS STREET • TUCSON, ARIZONA 85701

April 17, 1980

Norman Arno
Chief, Engineering Division
Corps of Engineers, Los Angeles District
Department of the Army
P.O. Box 2711
Los Angeles, CA 90053

RE: Master Plan-Tucson Diversion Channel
(Recreational Development Program)

Thank you for the opportunity to comment upon the subject plan. The data presented in the report is comprehensive and clearly stated.

The general, overall concept of the plan is excellent and will serve many needs and purposes.

We are now in the process of formulating the "Southeast Area Plan", the western boundary of which is Country Club Road. The most densely populated portion of our plan area falls within a three mile radius of the Wet Park site.

Future actions relative to the development of the park will definitely impact planning decisions in the southeast area. We would appreciate being kept up-to-date on any changes or new developments regarding this project.

Sincerely,

Suzanne C. McLean
Principal Planner

SCM/GHR/pah

ARIZONA GAME & FISH DEPARTMENT

2222 West Greenway Road Phoenix, Arizona 85023 942-3000

May 12, 1980

Mr. Norman Arno, Chief
Engineering Division
Department of the Army
Los Angeles District, Corps of Engineers
P. O. Box 2711
Los Angeles, California 90053

Dear Mr. Arno:

The Arizona Game and Fish Department has reviewed the Tucson Diversion Channel Master Plan. The concept behind this plan is excellent. The availability of additional water-related recreational facilities in the Tucson metropolitan area will enhance the quality of the community.

Tucson's need for this type of facility is increasing and our Department has recognized this need. We are currently evaluating an urban lakes fisheries research project. The results of this project will be incorporated into urban fisheries management plans in the near future. The Ajo detention facility would provide an additional urban fishery, and we support the concept of such facilities.

Thank you for the opportunity to comment on this plan.

Sincerely,

Robert A. Jantzen, Director

Vashti C. Supplee
Habitat Evaluation Specialist
Tucson Regional Office

VCS:dd

cc: Planning and Evaluation Branch, Phoenix

APPENDIX B
ENVIRONMENTAL ASSESSMENT
OF
RECREATIONAL DEVELOPMENT
AT THE
TUCSON DETENTION BASIN

January 1980

Prepared by Cliff Rader
Environmental Quality Section

A. Description of Proposed Project. The proposed project is the development of a recreational lake and related dryland park facilities at the Tucson Detention Basin in South Tucson, Arizona. Due to a shortage of funds, the project will be developed in two phases: Phase 1 will consist of the construction of the dryland park facilities (e.g., picnic tables, turf fields, bicycle-motocross track); Phase 2 will be the construction of a tertiary sewage treatment plant and a 60-acre lake with supporting boating, fishing. Swimming will not be allowed. A more complete description of the proposed project can be found in the master plan. But because the project's design is still not finalized, only general comments about it will be made in this environmental assessment.

B. Description of Existing Environment.

1. Setting. The city of Tucson in southern Arizona, has developed into a metropolitan center of 500,000 people despite the desert environment and a limited supply of water. The Saguaro National Monument, which contains nationally renowned desert life forms, borders Tucson's east and west sides.

2. Proposed Project Site. The proposed project site is located in a relatively undeveloped area of South Tucson. There is residential development on the north and west of the detention basin, and commercial buildings on the east. But the south side of the basin has had very little urban development. A hospital, a juvenile detention facility, county motor vehicle registration offices, and a communication center are the only buildings to the south.

3. Physical Characteristics. The area of the detention basin is approximately 120 acres, surrounded by a levee about 20 feet high. The land within the basin is relatively level. A low flow channel crosses the middle of the basin from the inlet structure on the northeast to the outlet structure on the southwest. The poor elevation gradient does not allow for proper drainage, and therefore the southern half of the basin periodically ponds because of storm flows.

4. Sand Extraction Operation and Borrow Pit Excavation. A former sand extraction operation and borrow pit excavation are located in the southeast part of the basin, about 300 feet from the inlet structure, on approximately 8 acres.

5. Vegetation. The detention basin supports an assemblage of desert-grassland plant species that differ significantly from those found in the areas surrounding Tucson. Instead of containing the Saguaro cactus *(Carnegiea gigantea)* that predominates elsewhere, the detention basin is characterized by mesquite *(Prosopis* sp.), palo verde *(Cercidium* sp.), and desert broom *(Baccharis* sp.). In addition, a small number of cottonwood *(Populus* sp.) trees are growing near the inlet.

6. Desert "Riparian" Community. This desert "riparian" community is probably caused by the additional moisture resulting from the impounding water in the detention basin. Several grasses, including Johnson grass (*Sorghum* sp.) and canary grass (*Phalaris* sp.) are growing in the areas where water is periodically confined.

7. Creosote Bush-Scrub Community. A creosote bush-scrub community is located on lands outside of the detention basin levees.

8. Fauna. Animal species present in the detention basin are typical of desert environments. Brief field observations included sightings of large numbers of jackrabbits (*Lepus* sp.) and Gambel quail (*Lophortyx gambelii*). Ground squirrels and a few lizards were also seen.

9. Endangered Species. No rare or endangered animal or plant species are known to exist in the project area.

C. Environmental Impacts.

1. Habitat Loss. Development of the detention basin for the specified recreation designs would cause a severe reduction in the habitat value of the area. At present, the basin serves as a refuge for fauna within the urban confines of Tucson. The introduction of recreation facilities and associated large numbers of people will not be compatible with the easily disturbed animals now present. Moreover, a large portion of the natural vegetation will be removed during the development of the recreational facilities. The design plans for landscaping with native vegetation and preserving existing vegetation along an approximately 200-foot wide strip bordering the northern and western levees and to landscape with native vegetation to lessen the impact of vegetation loss. But despite the preservation of this plant life, the expected high visitor rates in this area will disturb any remaining fauna.

2. Change in Habitat by Creation of 60-Acre Lake. Creating a 60-acre lake within the desert environment will cause a major change in the existing habitat. Although the area is now periodically inundated with storm waters, the proposed lake will exist year-round. Because of the volume of water, available moisture in this area will increase dramatically. The species composition will change with the introduction of waterfowl and fish. Native animal species remaining in the area will be only those tolerant of human activity.

3. Lake Construction. The construction of the lake will require the excavation of approximately 800,000 cubic yards of material. At present, plans call for using 400,000 cubic yards of material on site for fill and esthetic mounding. An additional 400,000 cubic yards of material will be relocated to the adjacent county-owned land. But the disposal of this material will result in the loss of approximately 40 acres of creosote-bush habitat.

4. Water Usage. The city of Tucson has in recent years become increasingly aware of its dwindling water supply. Its rapid population growth and expansion of agriculture and business has caused a dramatic increase in the demand for water. This increased demand has significantly reduced the ground water reserves on which Tucson relies solely for its water supply. Present estimates indicate that the water table has fallen from 10 to 40 feet in various places during the past 5 years. In view of the fragile nature of Tucson's water supply, therefore, any proposal to alter water usage patterns should be carefully examined.

5. Filling of the Lake. The initial filling of the lake will require approximately 400 acre-feet of ground water. Evaporation will cause the water level in the lake to drop each summer. The project design calls for the construction of a tertiary sewage treatment plant to ensure that there will be enough water to fill the lake each winter. This plan will treat excess secondary-treated effluent from the nearby Randolph Treatment Plant. Right now the excess effluent is discharged into the Santa Cruz River. Diverting the excess secondary-treated effluent (approximately 40 acre-feet year) to the proposed tertiary treatment plant will mean that 40 acre-feet of water per year will no longer be available for recharge into the ground water table downstream of Tucson.

6. Improvement of Present Sewage Collection System. In order to provide enough water for all proposed usages, the present sewage-collection system must be improved so that the treatment plant can operate at maximum capacity. After water is supplied to other parks in the area, approximately 450 acre-feet per year of tertiary-treated water will be available for the lake. This, of course, represents a potential loss to groundwater recharge, because this water probably would have been recharged to the groundwater table if it had not been collected by the improved sewage system and diverted to the sealed-bottom lake.

7. Transportation. The development of the proposed park will increase traffic level within the area. It appears, however, that the existing roads will be able to absorb any expected increases.

8. Noise. Ambient noise levels are expected to increase both during and after construction of the proposed park, potentially affecting nearby residents and the hospital. Aircraft from Davis Monthan Air Force Base and Tucson Airport will fly overhead on occassion. But generally flight patterns do not cross the project.

9. Air Quality. Construction activities will create a temporary decrease in air quality levels.

10. Cultural Resources. The proposed activity is not near any of the sites listed or eligible for listing in the National Register of Historic Places.

D. Conclusion. The Environmental Assessment has determined that no significant impact upon the quality of the human environment is expected from the proposed activity. Therefore, an Environmental Impact Statement will not be prepared. Should significant additional information be developed concerning the proposed action or should the proposed action be significantly modified, the effect of the action will be reevaluated. A supplemental assessment, which may conclude that as EIS is required, will then be prepared.

GWYNN A. TEAGUE
Colonel,C E
District Engineer

7 March 1980.
Date

APPENDIX C
SOILS REPORT
(Attached report is not edited.)

SOILS INVESTIGATION REPORT

TUCSON DIVERSION CHANNEL

DETENTION BASIN LAKE

SEPTEMBER 1977

U. S. ARMY ENGINEER DISTRICT, LOS ANGELES

CORPS OF ENGINEERS

SOILS INVESTIGATION REPORT

TUCSON DIVERSION CHANNEL
DETENTION BASIN LAKE

INTRODUCTION

1. Authorization. This report is submitted in accordance with Service Request No. ED-E-77-39, dated 20 June 1977.

2. Purpose and scope. The report describes and presents the results of subsurface explorations conducted to establish soil types and conditions in the area of proposed construction. The report recommends (a) the allowable soil bearing capacity, (b) a vehicular pavement design, (c) alternative treatments for lake linings, (d) the location of a designated borrow area for lake lining construction, and (e) inlet erosion control measures. A supplemental report offering specific recommendations for a lake lining treatment with erosion control, along with riprap requirements would be submitted upon receiving detailed project criteria.

3. Site description. The location of the proposed project is in the detention basin of the Tucson Diversion Channel located in the southern portion of Tucson, Arizona. It lies within the Santa Cruz River drainage area. The topography is generally flat within the boundaries of a twenty foot wide berm around the perimeter of the basin. Shallow rooted scrub

growth, approximately six feet high, covers the northern one third of the basin and a ten foot deep borrow pit has been excavated in the northeast corner near the inlet. The remainder of the basin interior is essentially level and free of vegetation.

INVESTIGATIONS

4. Explorations. A subsurface exploration at the site of the proposed project was conducted during June 1977, using a power auger with a 16-inch diameter bucket. Ten test holes, TH 77-1 through TH 77-10, were drilled to depths of 30 feet. Standard penetration tests were conducted in each test hole. In these tests, a 140-pound hammer, with a 30-inch free fall, was used to drive a standard sampling spoon having an outside diameter of 2 inches and an inside diameter of 1-3/8 inches. A record was made of the number of blows, N, required to advance the sampler one foot after the spoon was seated 6 inches into the bottom of the hole. The locations of the test holes are shown on plate 1. The materials encountered were visually classified and disturbed samples of representative materials were obtained for laboratory classification tests, moisture content determinations and compaction tests.

5. Laboratory tests. Mechanical analysis, Atterberg limits, moisture content determinations and compaction tests have been conducted on representative samples in accordance with EM 1110-2-1906. The soils were classified in accordance with the Unified Soil Classification System.

Results of tests are presented in the logs of test holes shown on plate 2.

6. Foundation conditions. The materials predominantly consist of clayey sands with minor occurrences of sandy clays and borderline sands. Moisture contents averaged 10 percent and ranged from 3 to 19 percent. Plasticity indexes ranged upwards to 28. The standard penetration tests revealed the sand materials to have relative densities ranging from medium dense to very dense and clay materials to have consistencies ranging from medium stiff to hard. In the southern half of the basin the materials are slightly to moderately cemented by caliche. Ground water was not encountered during the exploration. A proposed borrow area, designated for lake lining construction, is shown on plate 1 and consists of fine grained clayey sands and sandy clays. The plasticity indexes for the borrow range from 9 to 17.

7. Recreation lake. The initial lake concept consists of a surface area of 61 acres with a maximum depth of 30 feet. In order to estimate the seepage losses for the lake, a lining of compacted select material was first analyzed. The select material would consist of native silty and clayey sands and clays and silts. The lining thickness was a maximum of 6 feet along the bottom of the lake, tapering to 2 feet at the top. Permeability test results from the original Tucson Diversion Channel project were used in conjunction with current exploration materials and compaction data. The tests indicate that the lowest expected permeability for the lining would be about 0.02 feet per day when compacted to at least 95 percent of the maximum density (ASTM D 698)

at optimum moisture content. The expected seepage loss from the lake was calculated to be at least 1700 acre feet per year. In addition, the average annual evaporation loss is estimated to be 66 inches (340 acre feet per year) based on U. S. Weather Bureau sources. The expected seepage loss from a lake just consisting of 12 inches of compacted in-situ soil was calculated to be at least 10,000 acre feet per year.

DESIGN APPLICATIONS

8. Foundation design. Based on the results of the subsurface explorations and laboratory tests, the proposed structures may be adequately supported on continuous footings or thickened-edge slab-type foundations placed on undisturbed native materials or compacted fill. The allowable soil bearing capacity would be 1500 psf for footings based at a minimum depth of 12 inches below finished grade. Expected settlement due to the anticipated light footing loads would be negligible. It is recommended that the finished floor elevation of the structures be at least 6 inches above the surrounding grade. A vapor or capillary water barrier would not be required beneath slabs. All structural fills and backfills would be compacted to at least 95 percent of maximum density for a minimum depth of 3 feet below footings and within an area 5 feet outside of structures (ASTM D 1557). Other fills are considered non-structural and would be compacted to 90 percent of maximum density (ASTM D 698).

9. Flexible pavement design.

a. Design values. Based on test results on similar materials (clayey gravelly sands and clayey sands) a CBR value of 10 is adopted for the native

subgrade or fill from required excavation, compacted to 93 percent of maximum density.

b. Design criteria. The flexible pavement for the access roads and parking areas is designed in accordance with Department of the Army TM 5-822-5. No estimate of the frequency and type of vehicular traffic was furnished. The following assumptions must be verified by the project manager and the architect-engineer.

(1) Access roads. Class E road, traffic category III, design index 3.

(2) Parking areas. Class E road, traffic category I, design index 1.

c. Pavement section. The pavement sections required to satisfy the CBR and depthof compaction requirements are as follows:

(1) Access roads. A 1½-inch bituminous surface course, 5 inches of aggregate base course compacted to 100 percent of maximum density over 6 inches of subgrade compacted to 93 percent of maximum density (ASTM D 1557).

(2) Parking areas. A 1½-inch bituminous surface course, 4 inches of aggregate base course compacted to 100 percent of maximum density over 4 inches of subgrade compacted to 93 percent of maximum density (ASTM D 1557).

d. It is recommended that all the pavement sections be built-up at least 6 inches above the surrounding grade in order to provide adequate drainage of the pavement section.

10. Lake lining.

a. Alternative treatments. A lake lining would be required in order to minimize seepage losses. Five linings were analyzed and compared on a

cost versus seepage loss basis and consisted of the following treatments: (A) compacted select material, (B) enzymatic stabilized compacted select material, (C) a bentonite and select material mixture, (D) a bentonite membrane, and (E) a 20 mil PVC membrane. Typical sections of the linings are shown on figures 3 through 7. Table 1 summarizes the basis for estimating the lining costs, assuming the cross section to have 1V to 5H side slopes and a horizontal bottom.

Table 1

Lining Cross Sectional Data

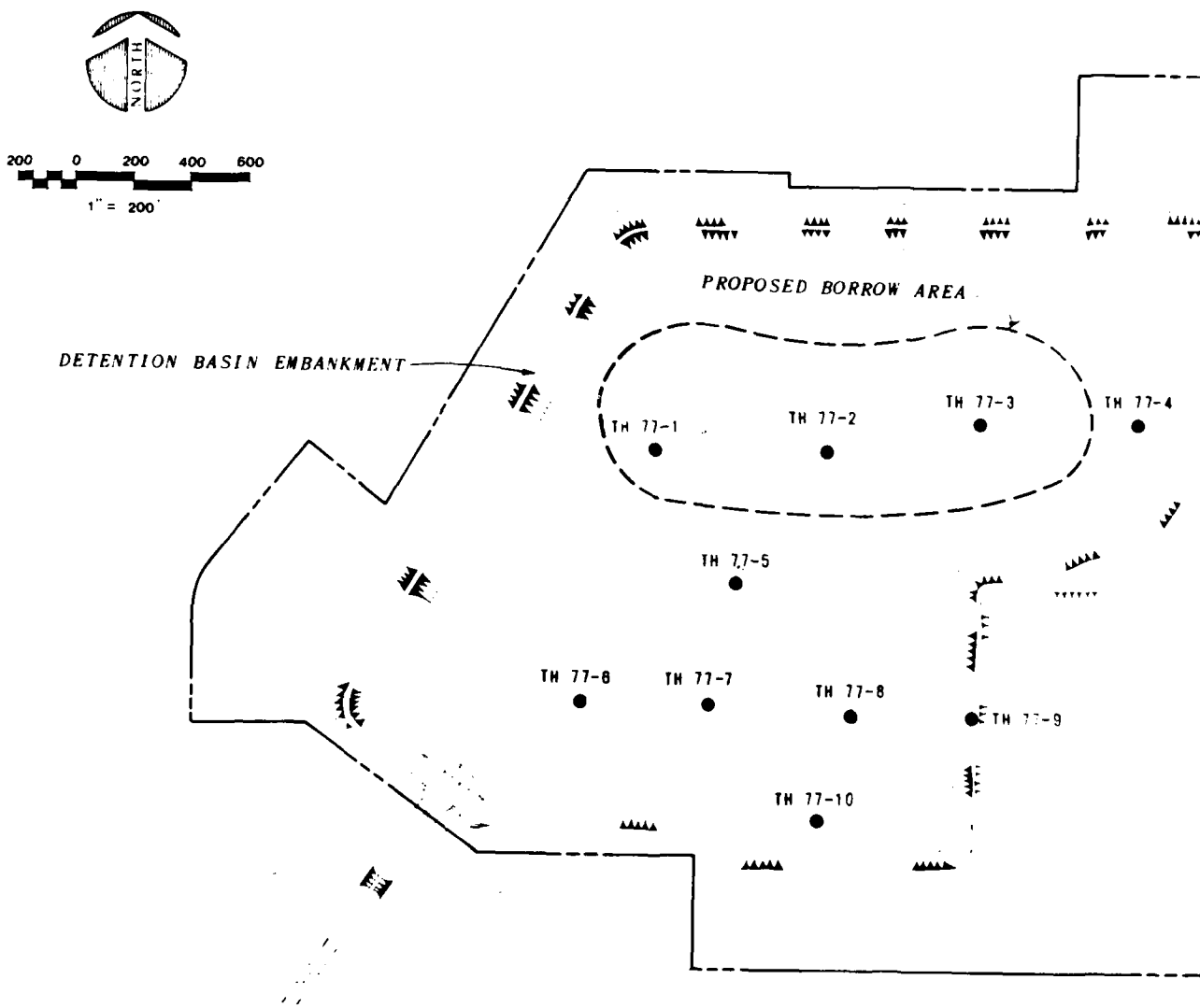
Lining Type	Bedding Material	Cover Material
(A) Compacted select material, 2 to 6 ft thick	None required	None required
(B) Compacted select material with enzymatic stabilizer, 1.5 ft thick	None required	None required
(C) Bentonite-select material mixture, 2 in. thick	4 in./select	6 in./select
(D) Bentonite membrane, 4 lbs. per sq. foot	6 in./select	6 in./select
(E) 20 mil PVC	8 in./sand	8 in./select

b. Comparative costs. Seepage losses were calculated for water surface areas of 15, 31, 46 and 61 acres along with maximum water depths of 20 and 30 feet. Figure 1 graphically compares lining costs with seepage losses and suggests the use of a membrane type lining for minimum water

losses. Figure 2 compares the present worth of the various linings based on a 25 year life, 6 percent annual interest rate, and a water cost of $250 per acre foot.

c. Design recommendations. A membrane type lake lining sandwiched within select material (see figures 5, 6, 7) is recommended. The recommendation will be confirmed, based on the final lake configuration, by a supplemental report. The lake side slopes would be no steeper than 1V to 5H. Select native material to be used in the lake lining would have at least 90 percent passing the No. 4 sieve, at least 30 percent passing the No. 200 sieve, and would be compacted to at least 90 percent of maximum density (ASTM D 698). Soil cement, grouted stone or other suitable treatments would be used as erosion protection for the liner where the filling water enters the lake and at the location of the overflow spillway. Erosion protection would be required along the shoreline within the zone of anticipated wave action where the zone of wave action is dependent on the lake size selected. A six inch layer of soil cement (8 percent by dry weight cement) would be adequate for erosion protection.

11. Lake berm. A berm would be required between the lake perimeter and the low flow channel. The channel-side slope would be no steeper than 1V to 3H. Materials for use in the berm construction may be obtained from required lake excavation and would be compacted to at least 90 percent of maximum density (ASTM D 698).

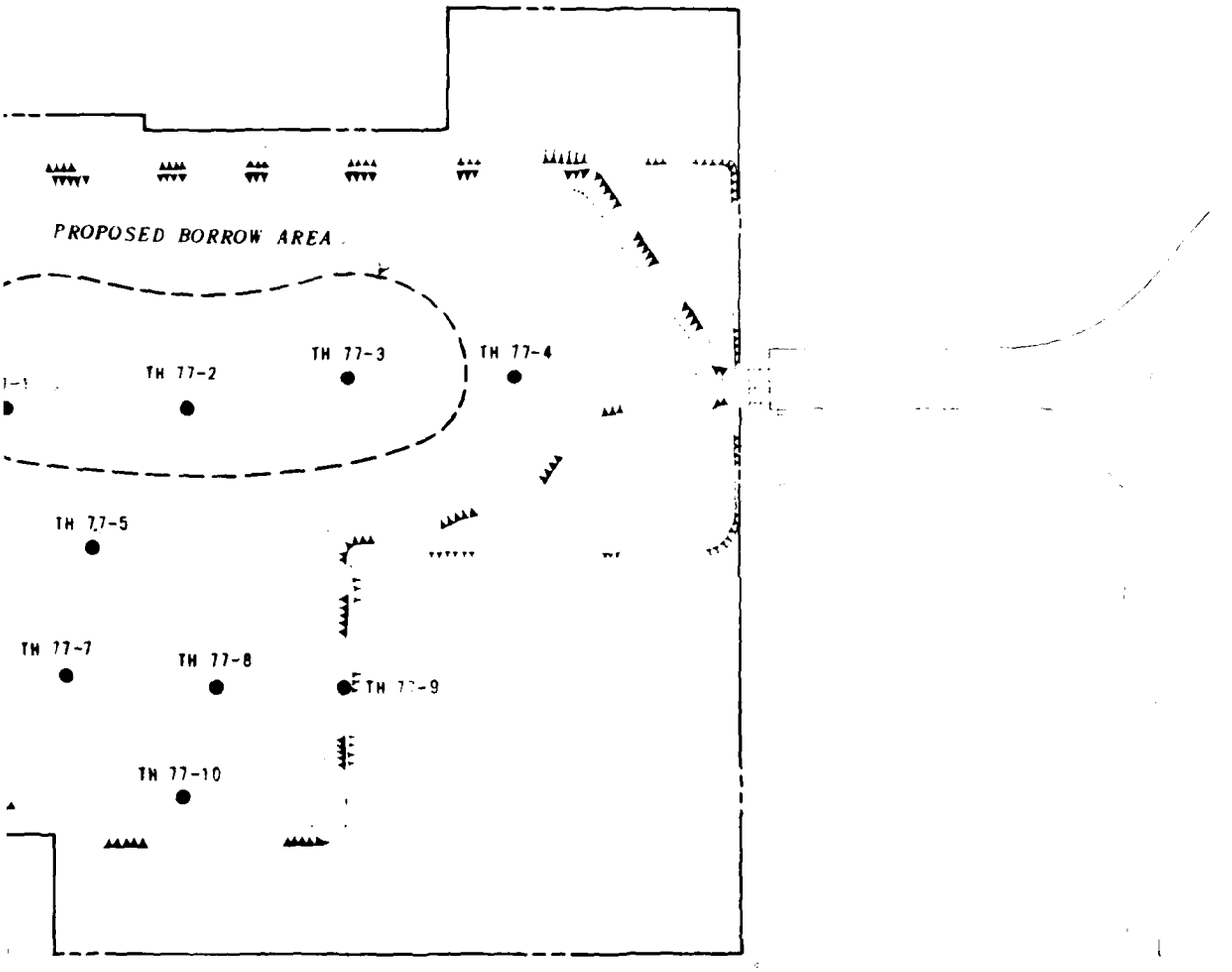


LEGEND

TH 77-1 ● LOCATION AND NUMBER OF TEST HOLE

NOTES

1. TEST HOLES WERE DRILLED DURING JUNE 1977 WITH A 16-
   DIAMETER BUCKET TYPE POWER AUGER.
2. FOR LOGS OF TEST HOLES SEE PLATE 2.



LEGEND

TH 77-1 ● LOCATION AND NUMBER OF TEST HOLE

NOTES

1. TEST HOLES WERE DRILLED DURING JUNE 1977 WITH A 16-INCH DIAMETER BUCKET TYPE POWER AUGER.
2. FOR LOGS OF TEST HOLES SEE PLATE 2.

SYMBOL	DESCRIPTION	DATE	APPROVAL
	REVISIONS		

U S ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY
DRAWN BY HR
CHECKED BY

TUCSON DIVERSION CHANNEL
DETENTION BASIN PARK

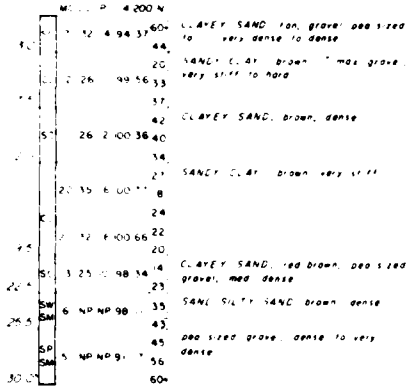
TEST HOLE LOCATIONS

SUBMITTED BY: CHIEF, ENGINEERING DIVISION — DATE
APPROVED: COLONEL, CORPS OF ENGINEERS — DATE
APPROVAL RECOMMENDED: CHIEF, PLANNING DIVISION — DATE
SPEC NO DACW09- B
DISTRICT FILE NO
DATE
SHEET OF SHEETS

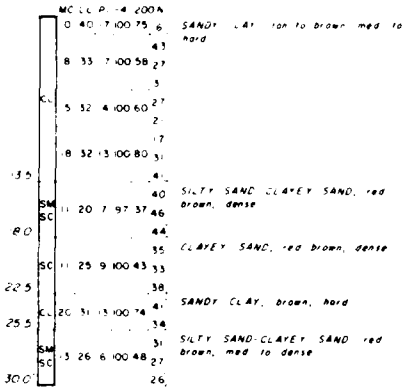
PLATE 1

2

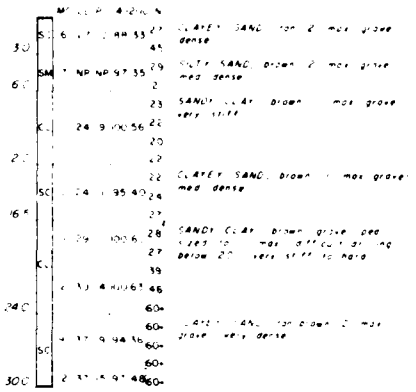
TH 77-1



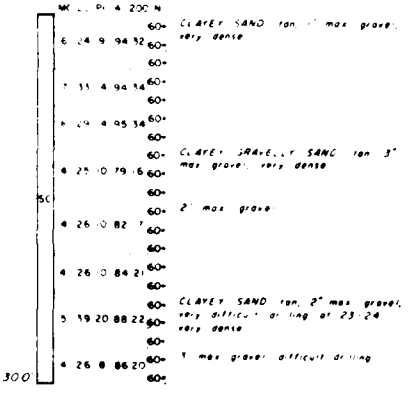
TH 77-2



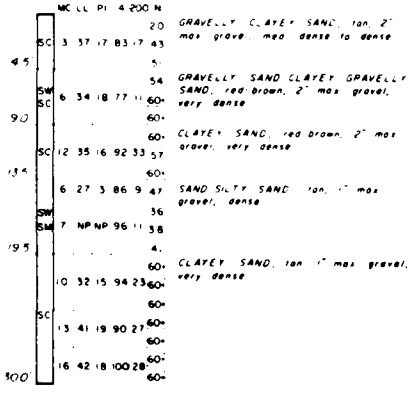
TH 77-3



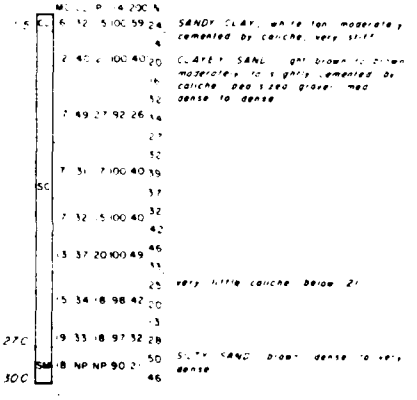
TH 77-4



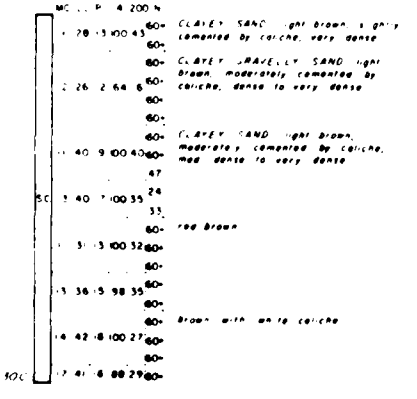
TH 77-5



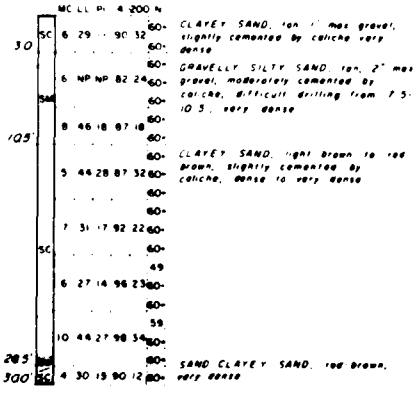
TH 77-6



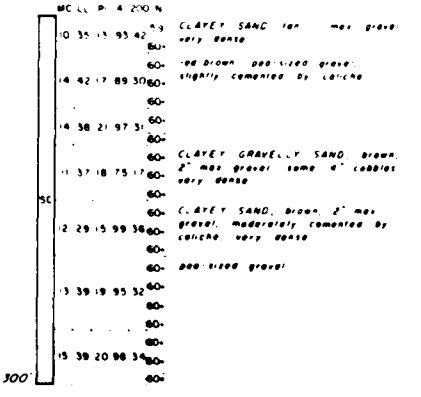
TH 77-8



TH 77-9



TH 77-10



UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS — More than half of material is larger than no. 200 sieve size	GRAVELS — More than half of coarse fraction is larger than no. 4 sieve size	Clean gravels	GW	Well graded gravels, gravel sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel sand mixtures, little or no fines
		Gravels with fines	GM	Silty gravels, gravel sand silt mixtures
			GC	Clayey gravels, gravel sand clay mixtures
	SANDS — More than half of coarse fraction is smaller than no. 4 sieve size	Clean sands	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands, gravelly sands, little or no fines
		Sands with fines	SM	Silty sands, sand silt mixtures
			SC	Clayey sands, sand clay mixtures
FINE GRAINED SOILS — More than half of material is smaller than no. 200 sieve size	SILTS AND CLAYS	Low liquid limit	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
		High liquid limit	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
Highly organic soils			Pt	Peat and other highly organic soils

NOTES:

1. Boundary Classifications: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example, GW-GC, well-graded gravel sand mixture with clay binder.
2. All sieve sizes on this chart are U. S. Standard.
3. The terms "silt" and "clay" are used respectively to distinguish materials exhibiting lower plasticity from those with higher plasticity. The coarser no. 200 sieve material is silt if the liquid limit and plasticity index plot below the "A" line on the plasticity chart (Table VI, Military Standard 619B) and is clay if the liquid limit and plasticity index plot above the "A" line on the chart.
4. For a complete description of the Unified Soil Classification System, see Military Standard 619B, dated 20 March 1974.

T H 77-3

M	L.L.	P.I.	#4	#200	%
SC			88	33	27
SM	NP	NP	97	35	29
SC	24	9	[illegible]	56	22
SC	24	11	95	43	24
					28
					27
					19
					46
					60+
					60+
SC					60+
					60+

CLAYEY SAND, tan, 2" max grave dense

SILTY SAND, brown, 2" max grave med. dense

SANDY CLAY, brown, max grave very stiff

CLAYEY SAND, brown, 1" max gravel, med. dense

SANDY CLAY, brown, grave pea sized to 1", very difficult drilling below 20', very stiff to hard

CLAYEY SAND, tan brown, 2" max grave, very dense

T H 77-6

M	L.L.	P.I.	#4	#200	%
CL			100	59	24
					4
SC			100	40	20
					14
	44	27	92	46	34
					17
					12
	7	3	100	40	39
SC					17
	32	15	100	40	32
					42
	37	20	100	49	46
					33
					18
	34	18	98	42	26
					3
	33	8	97	32	28
SM	NP	NP	90	2	50
					46

SANDY CLAY, white tan, moderately cemented by caliche, very stiff

CLAYEY SAND, tan brown to brown, moderately to slightly cemented by caliche, pea sized gravel, med. dense to dense

very little caliche below 21'

SILTY SAND, brown, dense to very dense

T H 77-7

M	L.L.	P.I.	#4	#200	%
	16	2	70	60	30
					60+
CL	15	38	69	99	56
					60+
					60+
					60+
	28	13	[illegible]	44	60+
					60+
					60+
	33	18	[illegible]	35	42
					38
					25
SC	37	17	100	31	37
					35
					52
	38	19	100	33	56
					60+
					60+
	33	6	100	37	60+
					60+
	33	15	100	28	60+
					60+

60'

100'

SANDY CLAY, brown, pea sized gravel, slightly cemented by caliche, hard drilling below 4', hard

CLAYEY SAND, red brown, slightly to moderately cemented by caliche, very dense to med. dense

2" max grave

2" max gravel

very difficult drilling below 27'

T H 77-10

M	L.L.	P.I.	#4	#200	%
	35	[illegible]	93	42	43
					60+
					60+
	42	[illegible]	89	30	60+
					60+
					60+
	38	21	97	31	60+
					60+
	37	18	75	[illegible]	60+
SC					60+
					60+
	29	15	99	38	60+
					60+
					60+
					60+
	39	19	95	32	60+
					60+
					60+
					60+
	39	20	98	34	60+
					60+

300'

CLAYEY SAND, tan, max grave very dense

red brown, pea sized gravel, slightly cemented by caliche

CLAYEY GRAVELLY SAND, brown, 2" max gravel, some 4" cobbles, very dense

CLAYEY SAND, brown, 2" max gravel, moderately cemented by caliche, very dense

pea sized gravel

LEGEND

T H ⊕	LOCATION AND NUMBER OF TEST HOLE
M C	FIELD MOISTURE CONTENT IN PERCENT OF DRY WEIGHT
L L	LIQUID LIMIT
P I	PLASTICITY INDEX: LIQUID LIMIT MINUS PLASTIC LIMIT
N P	NONPLASTIC
#4	PERCENT OF MATERIAL BY WEIGHT PASSING NO. 4 SIEVE
#200	PERCENT OF MATERIAL BY WEIGHT PASSING NO. 200 SIEVE
N	NUMBER OF BLOWS OF A 140 POUND DROPHAMMER FALLING 30 INCHES REQUIRED TO DRIVE A SAMPLING SPOON ONE FOOT. OUTSIDE DIAMETER OF SPOON IS 2 INCHES, INSIDE DIAMETER IS 1 3/8 INCHES. PROCEDURE IS CALLED STANDARD PENETRATION TEST
W	DEPTH TO WATER

SYMBOL	DESCRIPTION	DATE	APPROVED
	REVISIONS		

U. S. Army Engineer District
Los Angeles
Corps of Engineers

DESIGNED BY: | DRAWN BY: | CHECKED BY:

J. A. BLUM AND ASSOCIATES, ALBUQUERQUE, NEW MEXICO

TUSCON DIVERSION CHANNEL DETENTION BASIN PARK

LOGS OF EXPLORATION

SUBMITTED BY: | APPROVED: | SHEET

APPROVAL RECOMMENDED: | SPEC. NO. DACW09-[illegible]-B-[illegible] | OF

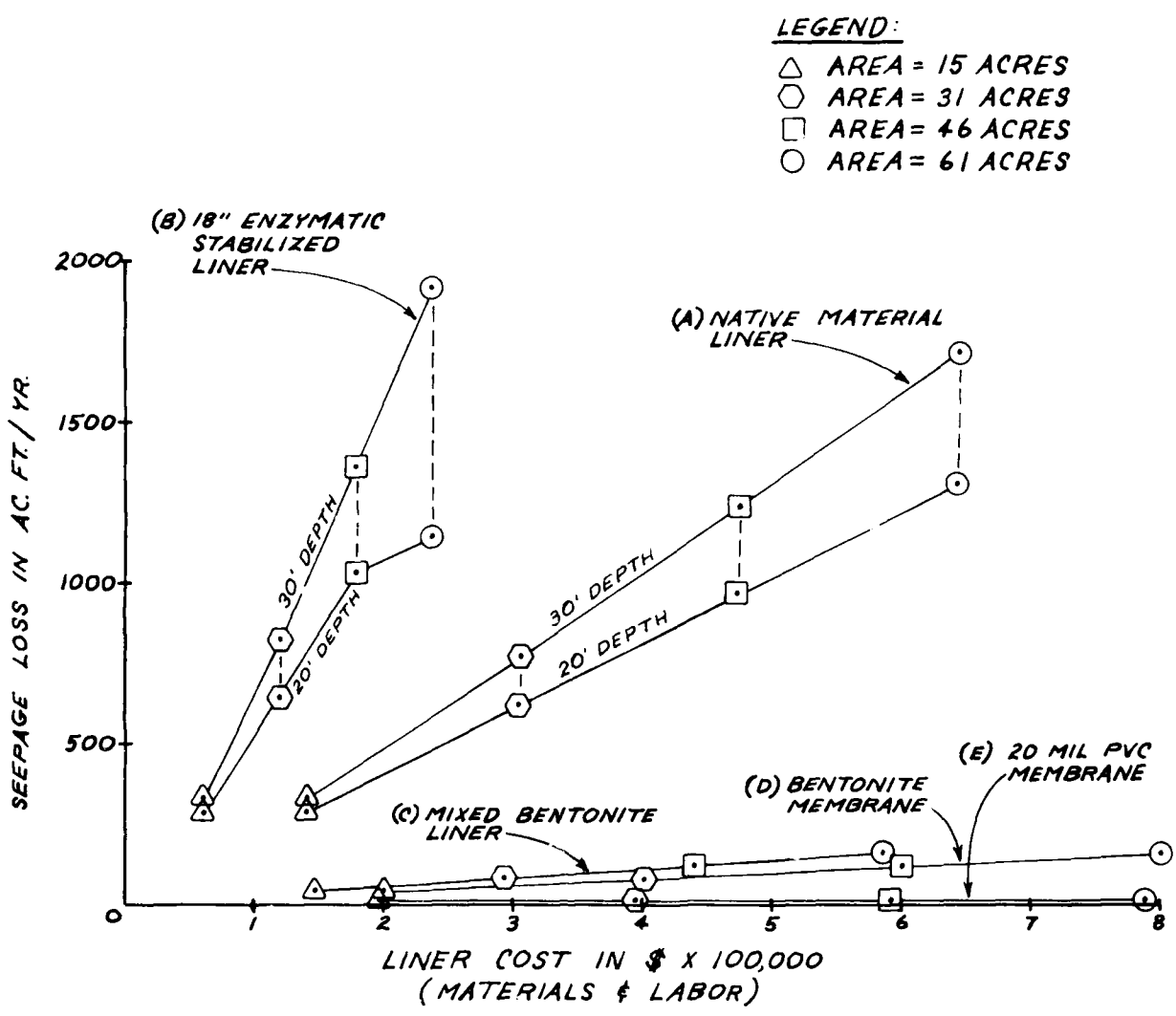
DISTRICT FILE NO. | SHEETS

DATE

PLATE 2

2

LINER COST vs SEEPAGE LOSS FOR FIVE LININGS

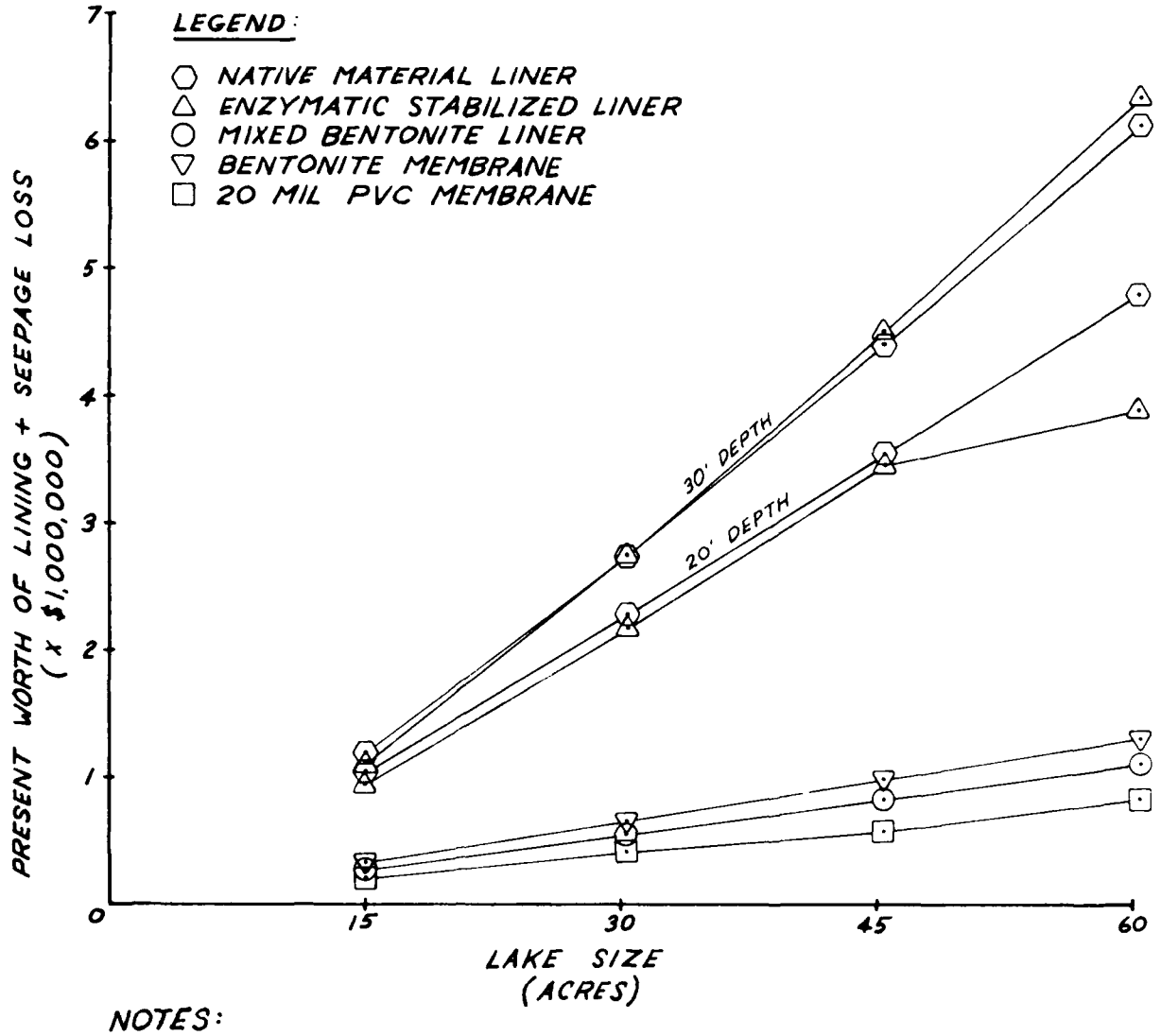


NOTES:

1. GENERAL LAKE CROSS SECTION ASSUMED TO HAVE 1:5 SIDESLOPES AND A FLAT BOTTOM 20 AND 30 FEET BELOW THE WATER SURFACE.
2. FEASIBILITY OF LININGS (B) AND (C) BASED UPON ANALYSIS BY SUPPLIER.

FIGURE 1

PRESENT WORTH OF LINING COST PLUS SEEPAGE LOSS COST



NOTES:

1. PRESENT WORTH BASED ON 25 YEAR LIFE, 6 PERCENT ANNUAL INTEREST RATE, AND WATER COST OF $250 PER ACRE FOOT.
2. COSTS OF BENTONITE AND PVC SYSTEMS ARE THE SAME FOR 20 FOOT AND 30 FOOT DEPTHS.

FIGURE 2

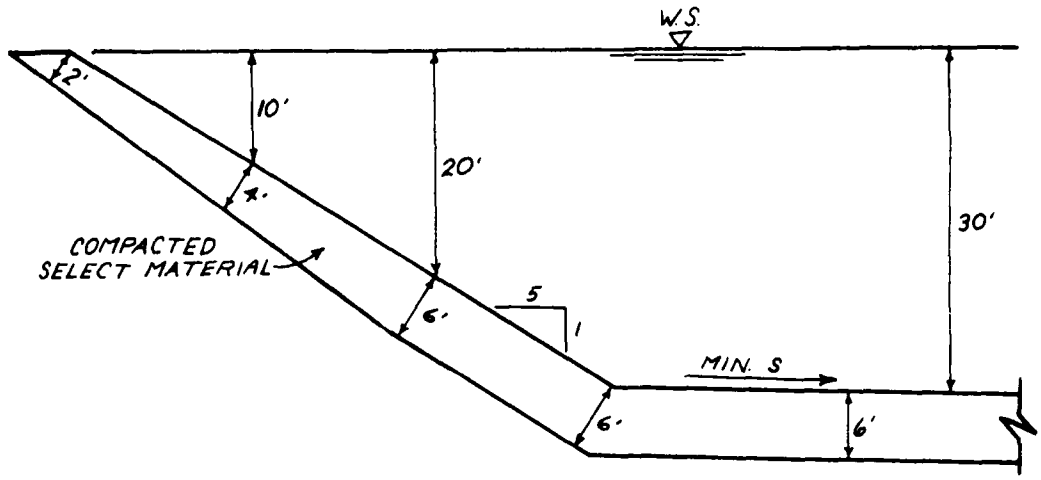


FIGURE 3: NATIVE MATERIAL LINER

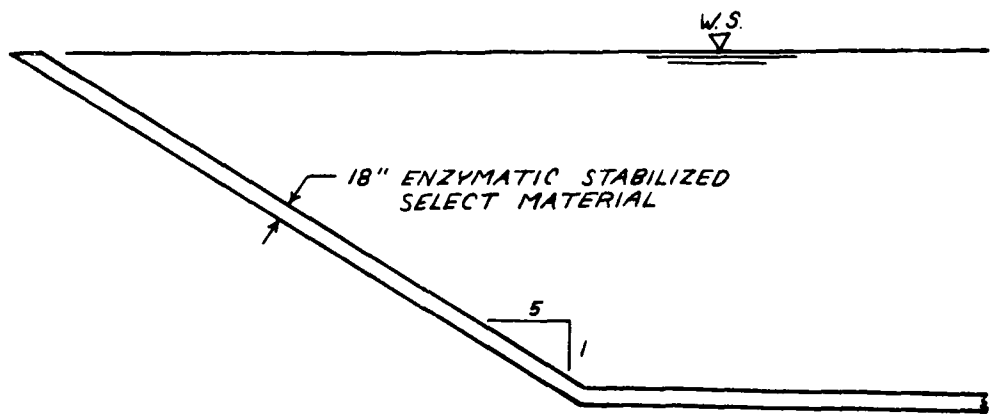


FIGURE 4: ENZYMATIC STABILIZED LINER

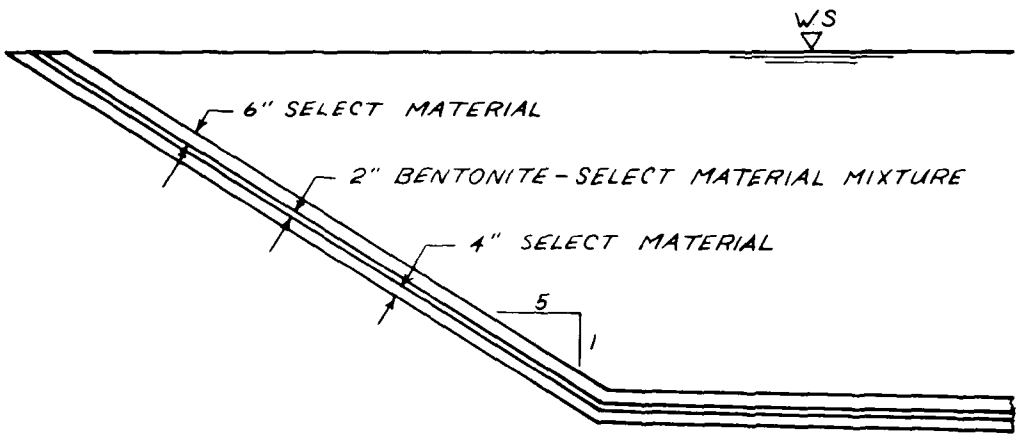


FIGURE 5: MIXED BENTONITE LINER

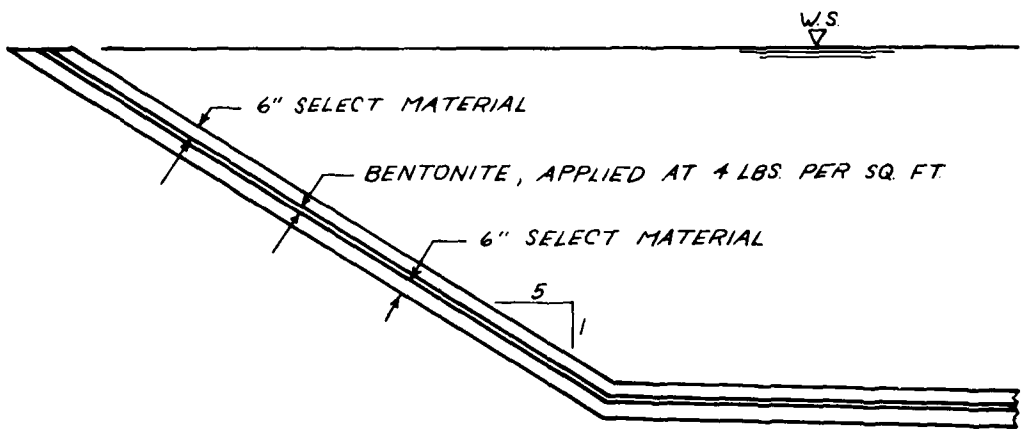


FIGURE 6: BENTONITE MEMBRANE

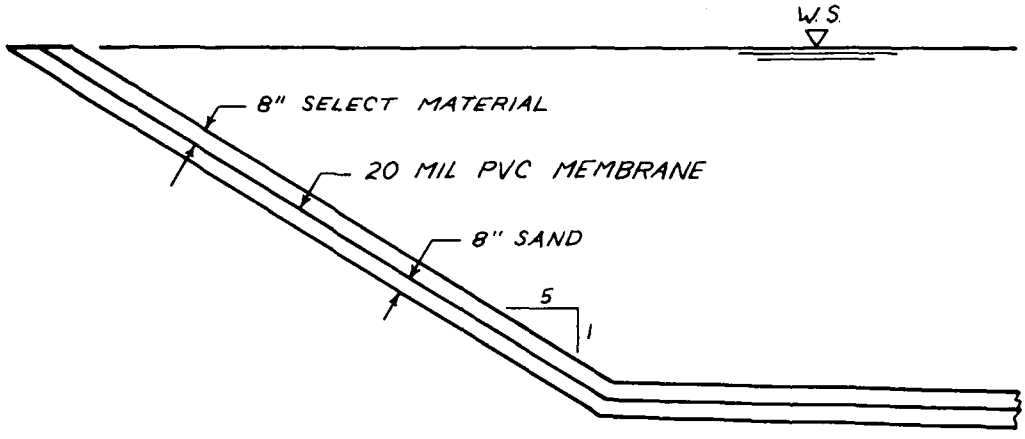


FIGURE 7: 20 MIL PVC MEMBRANE

APPENDIX D
Water Quality Standards for Recreation

A. **Water Quality Standards for Recreation.** The physical, biological, and chemical properties of the effluent from the Randolph Wastewater Treatment Plant are shown in Table 1. The type of effluent treatment that is needed for these properties is compared to the water quality requirements for recreation use establlished by the Arizona Department of Health Services. These water quality standards are shown in tables 2 and 3. These waste water reuse guidelines were based on (1) "Rules and Regulations for Reclaimed Wastes," Article 6, Part 4, by the Arizona State Department of Health, in which the minimum level of treatment specified is "secondary treatment," and (2) specific Federal criteria for what constitutes secondary treatment. It should be mentioned that the EPA guidelines are more stringent than those of the State, 30 mg/1 BOD compared with 35 mg/1 BOD, and 30 mg/1 total SS compared with 35 mg/1 total SS for the state. These two values have been incorporated in table 2, the values in parentheses reflect the anticipated change in the state guidelines to match the existing, more rigorous federal guidelines.

An analysis of these three tables reveals that if the level of suspended solids and nutrients were reduced, the effluent would meet recreation water quality requirements. The treatment process that could be used is discussed in Chapter 2, A.5 and Chapter 3, C.

The residential area that the Randolph plant serves is well established and not likely to change radically in the near future. Therefore, no major changes in the quality of the effluent during the life of the waste water treatment plant are anticipated.

The following describes some of the parameters given in table 1 that are used to evaluate the suitability of effluent for reuse:

- Dissolved solids is a general term used to describe the mineral content of water. Total dissolved solids (TDS) consist primarily of sodium, potassium, calcium and magnesium cations and carbonate, chloride, sulfate and nitrate anions. Other constituents usually present in small amounts may be silver, arsenic, iron, chromium, cadmium, lead, mercury, copper, zinc, etc. Generally speaking, water with a TDS of less than 1000 mg/1 is considered fresh; a TDS from 1000 to 10,000 mg/1 is considered brackish; a TDS from 10,000 to 25,000 mg/1 is considered saline; and a TDS greater than 25,000 mg/1 is considered seawater.

- Biological Oxygen Demand (BOD_5) is the most widely used parameter in describing organic pollution, applied to both waste water and surface waters. This parameter is a determination of the relative amount of dissolved oxygen that is used by micro-organisms in the biochemical oxidation of organic matter.

- Suspended solids (SS) generally describes the organic and inorganic particles that are not dissolved. Approximately 75 percent of suspended solids are organic in nature, generated by both plant and animal life. Organic compounds consist of combinations of carbon, hydrogen and oxygen. Other elements such as sulfur, phosphorus and iron may also be present. Suspended solids also encompass an ever increasing amount of synthetically produced organics that range

from very simple to extremely complex in structure. These synthetically produced organics include substances used as surfactants, phenols and argicultural pesticides. The presence of these substances has complicated waste water treatment in recent years because many of them cannot be, or are very slowly, decomposed biologically.

- The fecal coliform count is a measurement that generally indicates microbiological content including viruses and pathogenic organism. Fecal bacteria of the coliform group are primary indicators of fecal contamination and are of sanitary significance. Fecal coliform bacteria is often used to monitor recreational water quality.
- Phosphorus in its elemental form can be toxic to man and accumulates in much of the same way as mercury. Phosphorus as phosphate is a nutrient that is essential for plant life. Phosphate stimulates growth of aquatic plants such as algae which can result in eutrophication.
- Nitrogen comes in several forms - two gases, molecular nitrogen and nitrous oxide, and in five nongaseous forms of combined nitrogen, ammonia nitrite and nitrate, and amino and amide groups all of which are a significant part of the nitrogen cycle.
- Ammonia, organic nitrogen, nitrates and nitrites are the forms of nitrogen that are significantly present in waste water. Organic nitrogen and ammonia both of which are discharged in human wastes are, generally speaking, the initial forms of nitrogen present in sewage. As time progresses, bacterial action converts the organic nitrogen into ammonia, and then, under aerobic conditions, the ammonia is oxidized to nitrites and nitrates. Under anaerobic conditions nitrates are reduced to nitrites. Nitrites under anaerobic conditions are further reduced to nitrogen gas, or to a lesser degree, to ammonia. The relative proportions of these forms of nitrogen, therefore, are indicators of the freshness of waste water and the quality of treated effluent.
- Organic, ammonia and nitrite nitrogen present in waste water treatment plant effluent exert an oxygen demand in the receiving waters. In addition, the nitrate form of nitrogen serves as a nutrient for aquatic plants and promotes eutrophication of lakes.

Table 1. Quality of Effluent.

Parameter	Randolph Effluent (Average)		
Fecal Coliform N/100 m.1.	279		
5 Day BOD mg/1	15		
Dissolved Oxygen	1.8		
Turbidity Jackson Turbidity Units	30		
pH	7.4		
Suspended Solids mg/1	14		
Settleable Solids mg/1	6.0		
Chlorine Residual mg/1	0.9		
Total Dissolved Solids mg/1	486		
Phosphates (as PO_4) mg/1	18.2		
Iron (mg/1)	0.65		
Nickel (mg/1)	0.06		
Cadmium (mg/1)	0.008		
Chromium (mg/1)	0.03		
Copper (mg/1)	0.36		
Zinc (mg/1)	0.39		
Lead (mg/1)	0.04		
Manganese (mg/1)	0.05		
NITROGEN SPECIES	HIGH	LOW	MEDIAN
Ammonium Nitrogen (as N) mg/1	45.3	7.1	20.2
Nitrate Nitrogen (as N) mg/1	2.6	0.14	1.1
Nitrite Nitrogen (as N) mg/1	5.8	0.02	1.5

Table 2. Effluent Quality Requirements for Various Uses.

Use	Effluent Quality Requirements[a]						
	BOD5	Total SS	Total dissolved solids	Toxic Sub-stance	Total Phos-phorus	Total nitrogen	Bacterio-logical
Irrigation							
Fibrous or forage crops not intended for human consumption	35 (30)	35 (30)	709	b	c	c	c (1000)
Orchard crops-no direct application of water to fruit of foliage	35 (30)	35 (30)	709	b	c	c	c (1000)
Food crops-product subjected to physical or chemical processing sufficient to destroy pathogenic organisms	35 (30)	35 (30)	709	b	c	c	1000
Orchard crops-direct application to fruit or foliage	35 (30)	35 (30)	709	b	c	c	1000
Food crops that may be consumed in their raw state	10	10	709	b	c	c	200
Golf courses, cemeteries and similar areas	35 (30)	35 (30)	709	b	c	c	1000
School grounds, playgrounds, etc. where children are expected to play	10	10	709	b	c	c	200
Watering							
Farm animals other than producing dairy animals	35 (30)	35 (30)	709	b	c	c	c (1000)
Producing dairy animals	35 (30)	35 (30)	709	b	c	c	1000
Recreational Impoundments							
Esthetic enjoyment or involving only secondary contact	35 (10)	35 (10)	709	b	c (.15)		1000 (200)
Primary contact recreation	10 (5)	10 (5)	709	b	0.5	c	(2.3)
Groundwater Recharge							
Ponding on surface	35 (30)	35 (30)	409	b	c	c	1000
Well point	10 (5)	10 (5)	409	b	0.5	10	200

Notes: Figures in parentheses are anticipated future standards. Concentrations expressed in terms of mg/1. Bacteriological figures expressed in terms of fecal coliform group density (count) per 100 milliliters.

a. Based on "Effluent Parameters for Reclaimed Wastes," by Arizona Department of Health, April 1972.

b. Not to exceed United States Health Service drinking water standards.

c. No limit on concentration.

Table 3. Specific Standards for Protection Uses.

Parameter	Protected Uses					
		Recreation			Agricultural	
	Domestic Water Source	Full Body	Partial Body	Aquatic and Wildlife	Irrigation	Livestock Watering
Fedcal Coliform[a] (Units / 100 ml)						
1. Geometric Mean (5 Sample Minimum)	1000	200	1000	1000	1000	1000
2. 10% of Samples for 30-Day Period will not Exceed	2000	400	2000	2000	2000	2000
3. Single Sample will not Exceed	4000	800	4000	4000	4000	4000
pHb						
1. Maximum	NS	8.6	8.6	9.0	9.0	9.0
2. Minimum	NS	6.5	6.5	6.5	4.5	6.5
3. Maximum Charge due to Waste Discharge	NS	0.5	0.5	0.5	NS	NS
Trace Substances[b] (Maximum mg/l)						
Arsenic (AS As)	0.050 D	0.050 D	(c)	0.050 D	2.000 T	0.200 T
Barium (AS Ba)	1.000 D	1.000 D	(c)	NS	NS	NS
Boron (AS B)	NS	NS	(c)	NS	1.000 T	NS
Cadmium (AS Cd)	0.010 T	0.010 T	(c)	0.010 D[d]	0.050 T	0.050 T
Chromium (AS Cr, Hexavalent & Trivalent)	0.050 D	0.050 D	(c)	0.050 D	1.000 T	1.000 T
Copper (AS Cu)	NS	NS	(c)	0.050D	5.000 T	0.500 T
Lead (AS Pb)	0.050 D	0.050 D	(c)	LESS THAN 0.050 D[e]	10.000 T	0.100 T
Manganese (AS Mn)	NS	NS	(c)	NS	10.000 T	NS
Merciry (AS Hg)	0.002 T	0.002 T	(c)	LESS THAN 0.002 T[e]	——c	0.010 T
Selenium (AS Se)	0.010 D	0.010 D	(c)	——c	0.020 T	0.050 T
Silver (AS Ag)	0.050 D	0.050 D	(c)	0.050 D	NS	NS
Zinc (AS Zn)	NS	NS	(c)	0.500 D	10.000 T	NS
Ammonia (AS un-ionized NH_3)	NS	NS	NS	0.020	NS	NS
Cyanide (AS Cyandie ion & Complexes)	0.200	0.200	(c)	LESS THAN 0.020[e]	NS	0.200
Phenolics	0.005	0.005	(c)	0.005	NS	0.005
Sulfides (Total)	NS	NS	NS	LESS THAN 0.100[e]	NS	NS

For footnotes see end of table.

Table 3 (Continued)

Parameter	Protected Uses				
	Domestic Water Source	Recreation	Aquatic and Wildlife		Agricultural
		Full and Partial Body	Warm Water Fishery Habitat	Cold Water Fishery Habitat	Irrigation and Livestock Watering
Temperature[b,f] Heat added by a discharge or combination of discharges will not raise the natural ambient water temperature more than ____ degrees Celsius.	NS	3	3	1	NS
Turbidity[b,f] A discharge or combination of discharges will not cause the turbidity to exceed ____ Jackson turbidity units in:					
Streams	NS	50	50	10	NS
Lakes	NS	25	25	10	NS
Dissolved Oxygen[h] A discharge or combination of discharges will not lower the dissolved oxygen concentration to less than ____ mg/1.	NS	6	6	6	NS

Notes: Abbreviations used: NS, no standard; T, total trace substances; and D, dissolved fraction. Source of information used in table, "Water Quality Standards for Surface Waters, Arizona Water Quality Control Council, June 8, 1979.

a. For limits applicable to direct waste water reuse, see A.C.R.R. R9-20-400s.
b. Applies also to effluent dominated streams.
c. Too little is known about adverse effects for this use to select a number adequately.
d. For cold water fishery habitat, maxiumum cadmium concentration is 0.001 mg/1.
e. The maximum concentration for this use is set at the current minimum level of detection.
f. Temperature standard not applicable to impoundments owned by a firm or individual for the express purpose of providing or receiving heat wastes.
g. Standards are applicable to turbidity caused by activities including, but not limited to, construction, mining, logging, agriculture, and other similar nonpoint sources.
h. Dissolved oxygen.

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